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COMMITTEE ON THE PEACEFUL
USES OF OUTER SPACE

REPORT OF THE SCIENTIFIC AND TECHNICAL SUBCOMMITTEE ON THE WORK OF ITS THIRTY-THIRD SESSION

INTRODUCTION

1. The Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space held its thirty-third session at the United Nations Office at Vienna from 12 to 23 February 1996 under the chairmanship of Professor D. Rex (Germany).

2. Representatives of the following Member States attended the session: Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Cuba, Czech Republic, Ecuador, France, Germany, Greece, Hungary, India, Indonesia, Iran (Islamic Republic of), Iraq, Italy, Japan, Kazakstan, Lebanon, Mexico, Morocco, Nicaragua, Nigeria, Pakistan, Philippines, Poland, Portugal, Republic of Korea, Romania, Russian Federation, South Africa, Spain, Sudan, Sweden, Syrian Arab Republic, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland and United States of America.

3. Representatives of the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Economic Commission for Africa (ECA) attended the session.

4. Representatives of the following specialized agencies and other organizations in the United Nations system attended the session: World Health Organization (WHO), United Nations Industrial Development Organization (UNIDO) and International Atomic Energy Agency (IAEA).

5. Representatives of the Association of Space Explorers (ASE), European Space Agency (ESA), Committee on Space Research (COSPAR), International Astronautical Federation (IAF), and International Society for Photogrammetry and Remote Sensing (ISPRS) also attended the session.

6. A list of the representatives of Member States, specialized agencies and other international organizations attending the session is contained in document A/AC.105/C.1/INF.25.

7. On 12 February 1996, the Subcommittee adopted the following agenda:

1. Election of Chairman.

2. Adoption of the agenda.

3. Statement by the Chairman.

4. General exchange of views.

5. United Nations Programme on Space Applications and the coordination of space activities within the United Nations system.

6. Implementation of the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space.

7. Matters relating to remote sensing of the Earth by satellites, including, *inter alia*, applications for developing countries.

8. Use of nuclear power sources in outer space.

9. Space debris.

10. Questions relating to space transportation systems and their implications for future activities in space.

11. Examination of the physical nature and technical attributes of the geostationary orbit; examination of its utilization and applications, including, *inter alia*, in the field of space communications, as well as other questions relating to space communications developments, taking particular account of the needs and interests of developing countries.

12. Matters relating to life sciences, including space medicine.

13. Progress in national and international space activities related to the Earth environment, in particular progress in the geosphere-biosphere (global change) programme.

14. Matters relating to planetary exploration.

15. Matters relating to astronomy.

16. The theme fixed for special attention at the 1996 session of the Scientific and Technical Subcommittee: "Utilization of micro- and small satellites for the expansion of low-cost space activities, taking into account the special needs of developing countries."

17. Other matters.

18. Report to the Committee on the Peaceful Uses of Outer Space.

8. In view of the retirement of Professor J. Carver of Australia as its Chairman, the Subcommittee, at its 465th meeting, elected Professor D. Rex of Germany as its new Chairman.

9. In connection with the election of the new Chairman, a statement was made by the Chairman of the Group of 77, which is reflected in paragraph 195 of the section on other matters.

A. Meetings and documentation

10. The Subcommittee held 17 meetings.

11. A list of the documents which were before the Subcommittee is provided in annex I to the present report.

12. Following the adoption of the agenda, the Chairman made a statement outlining the work of the Subcommittee at its current session. He also reviewed the activities of Member States in the field of space exploration, including important advances that had been achieved as a result of international cooperation during the past year.

13. At the 465th, 466th, 468th and 470th meetings, the Chairman informed the Subcommittee that requests had been received from the permanent representatives of Algeria, Guatemala, Ireland, Jordan, Malaysia, Peru, Saudi Arabia, Slovakia, Tunisia, United Arab Emirates and the League of Arab States to attend the session. Following past practice, those delegations were invited to attend the current session of the Subcommittee and to address it as appropriate. That was without prejudice to further requests of that nature, and did not involve any decision of the Subcommittee concerning status, but was a courtesy that the Subcommittee extended to those delegations.

14. General statements were made by the following delegations: Argentina, Austria, Brazil, Bulgaria, Canada, Chile, China, Czech Republic, Ecuador, Germany, Hungary, India, Indonesia, Italy, Lebanon, Morocco, Nigeria, Pakistan, Philippines, Romania, Russian Federation, South Africa, Syrian Arab Republic, Turkey, United Kingdom and United States. General statements were also made by the representatives of ESCAP, ECA, ASE and IAF.

15. At the 466th meeting, the Director of the Office for Outer Space Affairs made a statement reviewing the work programme of the Office. At the 469th meeting, the Expert on Space Applications made a statement outlining the activities carried out and planned under the United Nations Programme on Space Applications.

B. Technical presentations

16. In accordance with General Assembly resolution 50/27, paragraph 17 (b) (vii), of 6 December 1995, a symposium on the theme "Utilization of micro- and small satellites for the expansion of low-cost space activities, taking into particular account the special needs of developing countries" was organized by COSPAR and IAF to complement discussions within the Subcommittee on the special theme. The first session of the symposium, entitled "Small satellite activities", was held on 12 February and was co-chaired by Mr. K. Doetsch, representing IAF, and Mr. W. Riedler, representing COSPAR. The second session of the symposium, entitled "The potential of micro- and small satellites", was held on 13 February and was co-chaired by Mr. J. Ortner, representing IAF, and Mr. K. Szegö, representing COSPAR. Mr. S. Grahn of COSPAR was the Rapporteur for both sessions of the symposium.

17. The presentations to the symposium included: "Small satellite programmes in developing countries" by Mr. P. Molette, Chairman of the Subcommittee on Small Satellites for Developing Nations, International Academy of Astronautics (IAA); "The European Space Agency's Small Missions Opportunities (SMO) Initiative" by Mr. F. Ongaro, Strategy Office, ESA; "Small satellite projects in Latin America" by Mr. C. Puebla Menne, Comité de Asuntos Espaciales de Chile; "An introduction to KITSAT Programme" by Mr. S. Kim, Deputy Project Manager, Satellite Technology Research Center, Korea Advanced Institute of Science and Technology; "Small satellite projects in Spain" by Mr. A. Giménez, Director General, Instituto Nacional de Técnica Aeroespacial (INTA); "Contribution of small and micro-satellites to scientific research" by Mr. K. R. Sridharamurthy, Indian Space Research Organization (ISRO); "French experience and prospects

in the use of small and micro-satellites for space science and applications" by Mr. P. L. Contreras, System Division Head, Toulouse Space Center, Centre national d'études spatiales (CNES); "NASA cooperation with developing nations on small satellite programmes" by Mr. J. Mansfield, Associate Administrator, Office of Space Access and Technology, National Aeronautics and Space Administration (NASA); "Brazilian small satellite programme and its particularities on space needs" by Mr. D. Ceballos, Instituto Nacional de Pesquisas Espaciais (INPE); and "The Sunset Project" by Mr. S. Mostert, University of Stellenbosch.

18. In response to General Assembly resolution 50/27, Mr. F. Alby, France, Mr. D. Mehrholz, Germany, Mr. R. Crowther, United Kingdom, Mr. G. Levin and Mr. A. Potter, United States and Mr. W. Flury, ESA, made special presentations on the complex issue of space debris and the solutions currently being adopted at the national level.

19. During the course of the session, scientific and technical presentations were made by Mr. L. Beckel, Austria, on the geospace global mapping project and the digital atlas of the world; Mr. R. R. Navalgund, India, on the application potential of the Indian Remote Sensing satellite (IRS-1C); Mr. M. Saoud, Morocco, on the applications of remote sensing, cartography and mapping; Mr. Z. Klos, Poland, on the Small Central European Satellite of Advanced Research (CESAR); Mr. V. Nikolaev, Russian Federation, on the collision of nuclear power sources in space with space debris; Mr. A. Yakovenko, Russian Federation, on the Russian space transportation system; Mr. Y. Zoubarev, Russian Federation, on cooperation on small satellites; Mr. B. Wade, United Kingdom, on interpretation and development of the safety principles for nuclear power sources in space; Mr. J. Remo, organizer, on the report on the United Nations International Conference on Near-Earth Objects; Mr. D. Prunariu, ASE, on the X-Prize: development of a reusable, single-stage, sub-orbital vehicle; Mr. D. McNally, International Astronomical Union (IAU), on solar reflectors, radio astronomy and access to the sky; Mr. L. W. Fritz, ISPRS, on the status of new commercial remote sensing satellites: high resolution imaging systems; and Ms. L. Stojak, International Space University (ISU), on ISU: design projects on small satellites for Earth observation of polar regions.

C. Recommendations of the Scientific and Technical Subcommittee

20. After considering the various items before it, the Subcommittee, at its 481st meeting, on 23 February 1996, adopted its report to the Committee on the Peaceful Uses of Outer Space containing its views and recommendations as set out in the paragraphs below.

I. UNITED NATIONS PROGRAMME ON SPACE APPLICATIONS AND THE COORDINATION OF SPACE ACTIVITIES WITHIN THE UNITED NATIONS SYSTEM

II. IMPLEMENTATION OF THE RECOMMENDATIONS OF THE SECOND UNITED NATIONS CONFERENCE ON THE EXPLORATION AND PEACEFUL USES OF OUTER SPACE

21. In accordance with General Assembly resolution 50/27, the Subcommittee continued its consideration of the above-mentioned items. In accordance with past practice, the Subcommittee considered the two items jointly.

22. The Subcommittee noted that the General Assembly, in paragraph 23 of resolution 50/27, had once again emphasized the urgency and importance of implementing fully the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82). The Subcommittee also took note of paragraph 18 of the same resolution, in which the General Assembly

considered that, in the context of the Subcommittee's consideration of the item, it was particularly urgent to implement the following recommendations:

"(a) All countries should have the opportunity to use the techniques resulting from medical studies in space;

"(b) Data banks at the national and regional levels should be strengthened and expanded and an international space information service should be established to function as a centre of coordination;

"(c) The United Nations should support the creation of adequate training centres at the regional level, linked, whenever possible, to institutions implementing space programmes; necessary funding for the development of such centres should be made available through financial institutions;

"(d) The United Nations should organize a fellowship programme through which selected graduates or postgraduates from developing countries should get in-depth, long-term exposure to space technology or applications; it is also desirable to encourage the availability of opportunities for such exposure on other bilateral and multilateral bases outside the United Nations system."

23. In response to the recommendations of the Working Group of the Whole to Evaluate the Implementation of the Recommendations of UNISPACE 82, contained in its report on the work of its ninth session, held in 1995 (A/AC.105/605, annex II, paras. 7-59), which were endorsed by the General Assembly in resolution 50/27, paragraph 20, the Subcommittee had before it the following documents: a report on international cooperation in the peaceful uses of outer space: activities of Member States (A/AC.105/614 and Adds.1, 2 and 3), containing information submitted by Member States in response to paragraph 9 of the report of the Working Group; a technical study on the use of remote sensing technologies for environmental applications, particularly in support of the recommendations of the United Nations Conference on Environment and Development (A/AC.105/632); and microsatellites and small satellites: current projects and future perspectives for international cooperation (A/AC.105/611) in response to paragraph 17 (e) and (g) of A/AC.105/571, annex II. In addition, the Subcommittee had before it annual reports, including information in response to paragraph 10, submitted by the following international organizations: International Telecommunication Union (ITU) (A/AC.105/634), World Meteorological Organization (WMO) (A/AC.105/633), European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) (A/AC.105/629), European Telecommunications Satellite Organization (EUTELSAT) (A/AC.105/627), International Telecommunications Satellite Organization (INTELSAT) (A/AC.105/626) and INTERSPUTNIK (A/AC.105/628).

24. In accordance with paragraph 19 of General Assembly resolution 50/27, the Subcommittee reconvened the Working Group of the Whole with a view to improving the execution of activities relating to international cooperation, particularly those included in the United Nations Programme on Space Applications, and to proposing concrete steps to increase such cooperation as well as to make it more efficient. The Working Group of the Whole was chaired by Mr. Muhammed Nasim Shah (Pakistan); it held six meetings between 14 and 22 February 1996 and adopted its report on 22 February 1996.

25. Having considered the report of the Working Group of the Whole, the Subcommittee decided at its 480th meeting, on 22 February 1996, to adopt that report, as contained in annex II to the present report, on the understanding that the recommendations contained therein would be carried out in accordance with paragraph 9 of General Assembly resolution 37/90 of 10 December 1982. The Subcommittee recommended that the Working Group be reconvened next year to continue its work.

A. United Nations Programme on Space Applications

26. Regarding the expanded United Nations Programme on Space Applications, the Subcommittee had before it the report of the United Nations Expert on Space Applications (A/AC.105/625). The report was supplemented by a statement by the Expert. The Subcommittee noted that the Programme on Space Applications for 1995 had been carried out satisfactorily, and commended the work accomplished by the Expert in carrying out the work programme. The Subcommittee noted that some of the activities that had been endorsed by the Subcommittee at its previous session had to be postponed for 1996 because of the financial situation of the United Nations.

27. The Subcommittee noted with appreciation that since its previous session additional contributions had been offered by various Member States and organizations and that they had been acknowledged in paragraphs 38 and 39 of the report of the Expert.

28. The Subcommittee continued to express its concern over the still limited financial resources available for carrying out the Programme and appealed to Member States to support the Programme through voluntary contributions. The Subcommittee felt that the limited resources of the United Nations should be focused on the highest priority activities, and noted that the Programme on Space Applications was the priority activity of the Office for Outer Space Affairs.

1. 1995-1996

United Nations training courses, workshops, expert meetings and symposia

29. With regard to the activities of the programme carried out in 1995 and 1996, the Subcommittee expressed its appreciation to the following:

(a) The Government of Spain for co-sponsoring the Meeting of Experts on the Development of Education Curricula for the Regional Centres for Space Science and Technology Education, hosted by the University of Granada and held at Granada, Spain, from 27 February to 3 March 1995;

(b) The Government of Sweden, represented by the Swedish Board for Investment and Technical Support (BITS), for co-sponsoring the Fifth United Nations Training Course on Remote Sensing Education for Educators, hosted by Stockholm University and the Swedish Space Corporation Satellitbild and held at Stockholm and Kiruna, Sweden, from 2 May to 9 June 1995;

(c) The Government of Gabon, as well as ESA, for co-sponsoring the United Nations/ESA Training Course on the Use of ERS-1 Data for the Mapping and Inventory of Natural Resources in Africa, organized for the benefit of African French-speaking countries and held at Libreville, from 15 to 19 May 1995;

(d) The Government of Zimbabwe, as well as ESA, for co-sponsoring the United Nations/ESA Workshop on the Applications of Space Techniques to Prevent and Combat Disasters, organized for the benefit of African English-speaking countries, hosted by the Environment and Remote Sensing Institute of the Scientific and Industrial Research and Development Centre and held at Harare, from 22 to 26 May 1995;

(e) The Government of Austria, as well as the State of Styria, the City of Graz, the Commission of the European Communities (CEC) and ESA, for co-sponsoring the United Nations/ESA/Austria Symposium on Space Technology for Improving Life on Earth, hosted by the Technical University of Graz and held at Graz, Austria, from 11 to 14 September 1995;

(f) The Government of Norway, as well as IAF, CEC and ESA, for co-sponsoring the United Nations/IAF/CEC/ESA Workshop on Space Technology for Health Care and Environmental

Monitoring in the Developing World, hosted by the Norwegian Space Centre, and held in conjunction with the 46th IAF Congress at Oslo, from 28 September to 1 October 1995;

(g) The Government of Mexico, as well as ESA, for co-sponsoring the United Nations/ESA Regional Conference on Space Technology for Sustainable Development, hosted by the Instituto Mexicano de Comunicaciones (IMC) and the Instituto de Geografía, Universidad Nacional Autónoma de México (IG/UNAM), and held at Puerto Vallarta, Mexico, from 30 October to 3 November 1995;

(h) ESA and the United Nations Trust Fund for New and Renewable Sources of Energy, for co-sponsoring the United Nations/ESA International Training Course for Asia and the Pacific Countries on Applications of ERS-1 Data, hosted by the European Space Research Institute (ESRI) of ESA, and held at Frascati, Italy from 13 to 24 November 1995;

(i) The International Centre for Theoretical Physics (ICTP) for co-sponsoring the United Nations/ICTP Workshop on Optics in Space Science and Technology, hosted by ICTP and held at Trieste, Italy, from 20 to 24 November 1995;

(j) The Government of Sri Lanka, as well as ESA, for co-sponsoring the Fifth United Nations/ESA Workshop on Basic Space Science, hosted by the Arthur C. Clarke Centre for Modern Technologies, and held at Colombo, Sri Lanka, from 11 to 13 January 1996.

30. The Subcommittee took note of the status of the planned United Nations workshops, training courses, symposia and conferences being held in 1996, which included the following activities, as described in the report of the Expert on Space Applications (A/AC.105/625, annex IV):

(a) United Nations/USA International Conference on Spin-off Benefits of Space Technology: Challenges and Opportunities, being organized in cooperation with the Government of the United States of America, to be held at Colorado Springs, Colorado, United States, from 9 to 12 April 1996;

(b) United Nations/ESA Workshop on Microwave Remote Sensing Applications, being organized in cooperation with the Government of the Philippines, to be held at Manila, from 22 to 26 April 1996;

(c) Sixth United Nations/Sweden International Training Course on Remote Sensing Education for Educators, being organized in cooperation with the Government of Sweden, to be held at Stockholm, from 6 May to 14 June 1996;

(d) United Nations/Chile/ESA Regional Workshop on Space Technology for Prevention and Mitigation of the Effects of Disasters, being organized in cooperation with the Government of Chile and ESA, to be held at Santiago, from 1 to 5 July 1996;

(e) United Nations/Austria/ESA Symposium on the Development and Dissemination of Space Technology, being organized in cooperation with the Government of Austria, the State of Styria, the City of Graz and ESA, to be held at Graz, Austria, from 9 to 12 September 1996;

(f) Sixth United Nations/ESA Workshop on Basic Space Science, organized in cooperation with the Government of Germany and ESA, to be held at Bonn, Germany, from 9 to 13 September 1996;

(g) United Nations/INTA/ESA International Conference on Small Satellite Missions, being organized in cooperation with the Government of Spain, to be held at Madrid, from 9 to 13 September 1996;

(h) United Nations/IAF/ESA Workshop on Education and Awareness - Space Technology and Application in the Developing World, being organized in cooperation with the Government of China, to be held at Beijing, from 3 to 6 October 1996;

(i) Second United Nations Regional Conference on Space Technology for Sustainable Development in Africa, being organized in cooperation with the Government of South Africa, to be held in South Africa, from 4 to 8 November 1996.

Long-term fellowships for in-depth training

31. The Subcommittee expressed appreciation to the Governments of Brazil and China as well as to ESA for having offered training fellowships in various areas relating to space activities for the period 1994-1995. The Subcommittee once again expressed appreciation to those Governments and agencies which had offered to renew fellowships for the period 1995-1996. The status of the 1995-1996 fellowships and the countries whose candidates have received fellowships were indicated in annex III of the report of the Expert.

32. The Subcommittee noted that it was important to increase the opportunities for in-depth education in all areas of space science, technology and applications projects through long-term fellowships.

Technical advisory services

33. The Subcommittee took note of the technical advisory services being provided by the United Nations Programme on Space Applications, Office for Outer Space Affairs in support of regional space applications projects, as indicated in the report of the Expert:

(a) Assistance to the Government of Ecuador in promoting the regional operation, administration and funding of the remote sensing receiving station at Cotopaxi, Ecuador;

(b) Assistance to the Government of Chile in its follow-up, as *pro tempore* secretariat, of the recommendations of the Second Space Conference of the Americas;

(c) Assistance to the Government of the Republic of Korea in the growth of the Asia-Pacific Satellite Communications Council;

(d) Collaboration with ESA on the implementation of a project, entitled COPINE. This project will address one of the recommendations of the Dakar Regional Conference on Space Technology for Sustainable Development in Africa, held in October 1993, regarding the urgent need to establish an efficient communications network among African and European professionals and scientists at national, continental and intercontinental levels;

(e) Collaboration with ESA and the Department for Development Support and Management Services of the United Nations in follow-up activities related to the recommendations of the November 1995 Training Course on Applications of ERS-1 Data for Natural Resources, Renewable Energy and the Environment, held at Frascati, Italy;

(f) Collaboration with ESA on follow-up activities relating to the series of workshops on basic space science.

Promotion of greater cooperation in space science and technology

34. The Subcommittee noted that the United Nations was collaborating with international professional bodies in the space community to promote exchange of experience on space activities. In 1995, the Programme on

Space Applications co-sponsored the United Nations/IAF/CEC/ESA Workshop on Space Technology for Health Care and Environmental Monitoring in the Developing World, held at Oslo, from 28 September to 1 October 1995, in conjunction with the 46th IAF Congress. Participants at the Workshop also attended the Congress.

35. The Subcommittee noted that in 1996, the Programme would co-sponsor the participation of scientists from developing countries in the Thirty-First Scientific Assembly of COSPAR, to be held at Birmingham, United Kingdom, from 14 to 21 July 1996, and the United Nations/IAF/ESA Workshop on Education and Awareness - Space Technology and Application in the Developing World, to be held at Beijing, from 3 to 6 October 1996 in conjunction with the 47th IAF Congress.

2. 1997

United Nations training courses, workshops and symposia

36. The Subcommittee recommended the approval of the following programme of training courses, workshops and symposia proposed for 1997:

(a) Seventh United Nations/Sweden International Training Course on Remote Sensing Education for Educators;

(b) Second United Nations Workshop on Payloads on Small Satellites;

(c) United Nations International Training Course on Communications and Information Technology for Development;

(d) Fourth United Nations/ESA Training Course on ERS Data Applications;

(e) A United Nations workshop on space technology as a tool for cleaning up and rehabilitating the environment.

B. International space information service

37. The Subcommittee noted with satisfaction that the Office for Outer Space Affairs continued to develop an international space information system, including both information within the United Nations system and access to external databases.

38. The Subcommittee noted with satisfaction the publication of a document entitled "Seminars of the United Nations Programme on Space Applications: selected papers on remote sensing, satellite communications and space science" (A/AC.105/621).

C. Reports

39. The Subcommittee took note with appreciation of the reports submitted to it by Member States and international organizations in response to the recommendations of the Working Group of the Whole in its report on the work of its ninth session. It also noted with satisfaction that the Secretariat had prepared technical studies on microsatellites and small satellites (A/AC.105/611) and the use of remote sensing technologies for environmental applications (A/AC.105/632).

D. Coordination of space activities within the United Nations system and inter-agency cooperation

40. The Subcommittee noted that the General Assembly, in its resolution 50/27, had reaffirmed its request to all organs, organizations and bodies of the United Nations system and other intergovernmental organizations working in the field of outer space or on space-related matters to cooperate in the implementation of the recommendations of UNISPACE 82.

41. The Subcommittee noted with satisfaction that the Inter-Agency Meeting on Outer Space Activities was convened at the United Nations Office at Vienna, from 7 to 9 February 1996, and that its report (A/AC.105/630) was before the Subcommittee. The Subcommittee took note of the information provided on the progress achieved in coordinating the space activities of the organizations of the United Nations system and expressed its appreciation for the report of the Secretary-General entitled "Coordination of outer space activities within the United Nations system: programmes of work for 1996 and 1997 and future years" (A/AC.105/631).

42. The Subcommittee continued to stress the necessity of ensuring continuous and effective consultations and coordination in the field of outer space activities among organizations within the United Nations system and the avoidance of duplication of activities. The Subcommittee noted that future sessions of the Inter-Agency Meeting on Outer Space Activities would be convened at the United Nations Office at Vienna, and hosted by the Office for Outer Space Affairs, prior to the sessions of the Committee each year, without prejudice to any invitation by an interested agency to host a session at its headquarters.

E. Regional and interregional cooperation

43. The Subcommittee noted that the General Assembly, in its resolution 50/27, had reaffirmed its approval of the recommendations of UNISPACE 82 regarding the establishment and strengthening of regional mechanisms of cooperation, and their promotion and creation through the United Nations system. The Subcommittee noted with satisfaction that, in carrying out various activities in the implementation of the recommendations of UNISPACE 82, the Secretariat had sought to strengthen those mechanisms.

44. The Subcommittee noted with appreciation the efforts undertaken by the United Nations Programme on Space Applications, in accordance with General Assembly resolution 45/72 of 11 December 1990, in leading an international effort to establish regional centres for space science and technology education in existing national or regional educational institutions in developing countries. The Subcommittee also noted that, once established, each centre could expand and become part of a network that could cover specific programme elements in established institutions related to space technology in each region.

45. The Subcommittee further noted that the General Assembly, in its resolution 50/27, had endorsed the recommendation of the Committee that the centres be established on the basis of affiliation to the United Nations as early as possible, and that such affiliation would provide the centres with the necessary recognition and strengthen the possibilities of attracting donors and of establishing academic relationships with national and international space-related institutions.

46. The Subcommittee noted that during the consideration by the Fourth Committee of the General Assembly of the item on international cooperation in the peaceful uses of outer space, in November 1995, Brazil and Mexico had informed the Fourth Committee that they had reached agreement on all aspects relating to the establishment of the Centre for Space Science and Technology Education in Latin America and the Caribbean. In this regard, the delegations of those countries stressed their expectation that the necessary coordination between the organs of the United Nations that were involved in the matter and the host countries would further expedite the establishment of the Centre.

47. The Subcommittee noted that the Centre for Space Science and Technology Education in Asia and the Pacific had been inaugurated in India in November 1995, that participation in the governing board of the Centre and in its activities would be open to Member States of the region, and that, in due course and upon approval by its Governing Board, the Centre would grow into a network of nodes enabling it to fully utilize the resources and potential of the region. The Subcommittee noted with satisfaction that the first education programme of the Centre would begin in April 1996.

48. The Subcommittee noted that an amendment to the agreement establishing the Centre for Space Science and Technology Education in Asia and the Pacific, proposed by the delegation of the Islamic Republic of Iran, was under consideration by the Governing Board of the Centre.

49. Some delegations expressed the view that they were concerned about the procedural and substantial problems relating to the establishment of the Centre for the region of Asia and the Pacific. Those delegations stated that since there were serious differences on matters of principle in relation to the establishment of the Centre, and since the growth of the Centre into a network of nodes was an objective that had not been realized, it was necessary to carry out further consultations so that a fair and reasonable solution could be achieved.

50. Some delegations also expressed the view that consensus on the establishment and development of the Centre with the full understanding of all interested States in the region was required. Those delegations stated that there were still States in the region hesitating to sign the agreement; that it was important to establish a fuller understanding of the relationship between the Centre and the related programmes of regional institutions such as the ESCAP cooperative programme; and that there was a need to fully understand how the two programmes could operate as integrated regional components of the United Nations Programme on Space Applications. Those delegations expressed the hope that further efforts would be made by the Office for Outer Space Affairs to foster consensus on those matters among all interested States in the region.

51. Other delegations stated that during the entire process leading to the establishment of the Centre, both the Subcommittee and the Committee had been kept fully informed, and that all necessary steps had been taken to ensure transparency. They pointed out that the appropriate forum for making proposals relating to the functioning of the Centre was the Governing Board of the Centre, as only it could decide on matters such as the establishment of nodes and the relationship that the Centre should have with other international bodies.

52. The Subcommittee noted that the offers and commitments of both Morocco and Nigeria favoured, in each case, the early establishment, operation and long-term sustainability of a centre in Morocco for the French-speaking African countries, and in Nigeria for the English-speaking African countries. The Subcommittee also noted that both countries were developing cooperation agreements that would be entered into by the Member States concerned later in the year.

53. The Subcommittee noted that discussions were in progress with the parties concerned on the establishment of the regional centre for the Middle East. The Subcommittee also noted that the Syrian Arab Republic had indicated its interest in hosting such a centre for the region covered by the Economic and Social Commission for Western Asia (ESCWA).

54. The Subcommittee noted that discussions were in progress with the parties concerned on the establishment of the regional centre for Europe. In that connection, the Subcommittee also noted the offers of Greece, Romania and some other Member States to host, or serve as a node for, such a regional centre covering the region of the Economic Commission for Europe (ECE). The Subcommittee noted the nomination of a facility in Greece that amply fulfilled the requirements of the proposed regional educational centre, namely a facility that had hosted a United Nations workshop on space communications for development. The Subcommittee noted, in addition, that Romania had presented a detailed offer, including explicit infrastructure and financial arrangements. The Subcommittee further noted that Italy had reaffirmed

called for the establishment of a centre for the countries of central and eastern Europe. The Subcommittee noted that the delegations of Bulgaria, Greece, Poland, Romania and Turkey, after consultations among themselves, had agreed that, instead of establishing a centralized institution such as a centre, it would be more appropriate to establish an educational system consisting of a network of space science and technology education institutions, and that the activities of each member of the network would be in harmony with relevant existing institutions in Europe and open to international cooperation, to be determined after appropriate consultations.

55. The Subcommittee noted that the ECA secretariat was providing support for the activities of the ECA regional remote sensing centres, and that the ESCAP secretariat was implementing several of the recommendations contained in the Action Plan on Space Applications for Sustainable Development in Asia and the Pacific Region that had emanated from the Ministerial Conference on Space Applications for Development in Asia and the Pacific Region, held at Beijing in 1994.

56. The Subcommittee noted that a Cooperative Information Network Linking Scientists, Educators and Professionals in Africa (COPINE) project would offer an excellent opportunity to develop space applications for Africa, and that the proposed system would allow for the exchange of information needed to promote progress in health care, agriculture, education, science and technology, and the management and survey of natural resources and the environment. The Subcommittee noted that such cooperation would provide long-term benefits to the participating African and European countries and would contribute to economic growth in Africa.

57. The Subcommittee noted the contributions made by specialized agencies and other international organizations towards the promotion of international cooperation in space activities: the Food and Agriculture Organization of the United Nations (FAO) was continuing its activities relating to the remote sensing of renewable natural resources and environmental monitoring, including training courses and the support of development projects; ITU was continuing its work in the international coordination of space communications, including providing technical assistance to developing countries; WMO was continuing international cooperative programmes using space technology, including the World Weather Watch and the Tropical Cyclone Programme; the United Nations Educational, Scientific and Cultural Organization (UNESCO) was promoting applications of space technology for archaeology, and strengthening international and interdisciplinary cooperation between archaeological projects; UNIDO was continuing its work on spin-off benefits of space technology; the International Mobile Satellite Organization (Inmarsat) was continuing to develop its satellite communication system for maritime, aeronautical and land-mobile communications, including the development of small, low-cost terminals and the provision of technical assistance and training; INTELSAT was further developing its system for international satellite communications and broadcasting, including its programmes for training and technical assistance; ESA was continuing its programme of international cooperative space activities, including training programmes for the benefit of developing countries, support of the activities of the United Nations Programme on Space Applications and technical assistance projects; and ICAO was continuing its work towards implementation of communications, navigation and surveillance/air traffic management (CNS/ATM) systems.

58. The Subcommittee emphasized the importance of regional and international cooperation in making the benefits of space technology available to all countries by such cooperative activities as shared payloads, dissemination of information on spin-off benefits, ensuring compatibility of space systems and providing access to launch capabilities at reasonable cost.

59. Some delegations expressed the view that the Space Agency Forum could be invited to participate in the meetings of the Subcommittee at future sessions.

III. MATTERS RELATING TO REMOTE SENSING OF THE EARTH BY SATELLITES INCLUDING, *INTER ALIA*, APPLICATIONS FOR DEVELOPING COUNTRIES

60. In accordance with General Assembly resolution 50/27, paragraph 17 (a) (iii), the Subcommittee continued its consideration of the item relating to remote sensing of the Earth.

61. In the course of the debate, delegations reviewed the national and cooperative programmes in remote sensing. Examples were given of national programmes in developing and developed countries and of international programmes based on bilateral, regional and international cooperation, including programmes of technical cooperation between developing countries. Countries with advanced capabilities in the field, including some developing countries, described programmes to provide assistance to developing countries.

62. The Subcommittee took note of the continuing programmes of Argentina, Australia, Austria, Brazil, Canada, China, France, Germany, India, Indonesia, Japan, Morocco, Russian Federation, Ukraine, United States and ESA for remote sensing satellites. The Subcommittee noted that the launches of the European Remote Sensing (ERS-2) satellite and the RADARSAT satellite of Canada would provide valuable microwave data to complement the data from ERS-1 and from the Japanese Earth Resources Satellite (JERS-1), as well as the visible and infrared data from satellites of the Landsat, Resurs, SPOT, Indian Remote Sensing (IRS) and Marine Observation Satellite (MOS) series and that the launch of IRS-1C would also provide valuable visible and infrared data. The Subcommittee also noted the remote sensing systems being developed for future launch, including SAC-B and SAC-C of Argentina, FY-2 of China, RADARSAT-II of Canada, CBERS of China and Brazil, IRS-P3 of India, ADEOS-1 and 2 of Japan and the Tropical Rainfall Measuring Mission (TRMM) of the United States and Japan, and various systems of the Russian Federation. It also took note of the activities of ISPRS in promoting international cooperation in remote sensing and image processing. The Subcommittee heard a scientific and technical presentation on the remote sensing activities of India and Morocco, noted the useful applications of SPOT data in mapping desertification, and heard a presentation by ISPRS on high-resolution imaging systems, as described in paragraph 19 of the present report.

63. The Subcommittee reiterated its view that remote sensing activities should take into account the need to provide appropriate and non-discriminatory assistance to meet the needs of developing countries.

64. The Subcommittee emphasized the importance of making remote sensing data and analysed information openly available to all countries at reasonable cost and in a timely manner. The Subcommittee also recognized the example of international cooperation in WMO in the exchange of meteorological data as provided for in resolution 11.4/1 adopted at the XIIth WMO Congress on 21 June 1995. Some delegations called attention to the international cooperation given by some members through traditionally free and open provisions of meteorological satellite data, and encouraged those countries to continue that practice.

65. The Subcommittee considered that international cooperation in the use of remote sensing satellites should be encouraged, both through coordination of the operations of ground stations and through regular meetings between satellite operators and users. It noted the importance of compatibility and complementarity of existing and future remote sensing systems, as well as the need for continuity in the acquisition of data. The Subcommittee also noted the importance, particularly for developing countries, of sharing experiences and technologies, of cooperation through international and regional remote sensing centres, and of joint work on collaborative projects. The Subcommittee further noted the value of remote sensing systems for environmental monitoring and, in that context, stressed the need for the international community to utilize fully remote sensing data in an effort to implement fully the recommendations contained in Agenda 21[1] of the United Nations Conference on Environment and Development (UNCED), held in Brazil in 1992.

66. Some delegations expressed the view that the international community should organize, on an annual basis, an International Space Day, which would be celebrated through special events, such as symposia, conferences and technical meetings, in all countries.

67. Recalling General Assembly resolution 41/65, annex, of 3 December 1986, by which the Assembly had adopted the Principles Relating to Remote Sensing of the Earth from Outer Space, the Subcommittee recommended that at its thirty-fourth session it should continue its discussion on remote sensing activities conducted in accordance with those Principles during its consideration of the agenda item concerning remote sensing.

68. The Subcommittee recommended that the item should be retained on its agenda as a priority item for its next session.

IV. USE OF NUCLEAR POWER SOURCES IN OUTER SPACE

69. In accordance with General Assembly resolution 50/27, paragraph 17 (a) (iv), the Subcommittee continued its consideration of the item relating to the use of nuclear power sources in outer space.

70. The Subcommittee recalled that the General Assembly had adopted the Principles Relevant to the Use of Nuclear Power Sources in Outer Space, as contained in its resolution 47/68 of 14 December 1992. The Subcommittee noted that at its thirty-eighth session the Committee had recalled (A/50/20, para. 62) that it had agreed, at its thirty-seventh session, that the Principles should remain in their current form until amended, and that before amendment, proper consideration should be given to the aims and objectives of any proposed revision (A/49/20, para. 68). The Subcommittee agreed that, at the present time, revision of the Principles was not warranted.

71. The Subcommittee also recalled that at its previous session it had agreed (A/AC.105/605, para. 66) that regular discussions on that issue should continue at future sessions and that the Subcommittee and the Working Group on nuclear power sources should continue to receive the widest input on matters affecting the use of nuclear power sources in outer space and any contribution related to improving the scope and application of the Principles.

72. The Subcommittee noted the statement made by IAEA emphasizing that it was important that the safety principles for nuclear power sources in outer space should be consistent with the most recent international recommendations on radiation protection, which were based on the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, jointly adopted by FAO, IAEA, the International Labour Organization, the Organisation for Economic Cooperation and Development (Nuclear Energy Agency) and the Pan American Health Organization. The Subcommittee also noted that the new Safety Practice document on Emergency Planning and Preparedness for Re-Entry of a Nuclear-Powered Satellite had been approved by IAEA and was due to be published in its final form in 1996.

73. Mindful of the differences in the safety Principles applied for space and the safety standards for terrestrial systems, the Subcommittee agreed that the study of those developments, arising from the latest International Commission on Radiological Protection (ICRP) recommendations, should be continued.

74. In accordance with General Assembly resolution 50/27, the Working Group on the Use of Nuclear Power Sources in Outer Space was reconvened on 21 February 1996 under the chairmanship of Professor D. Rex (Germany). No further work was undertaken in the Working Group during the session.

75. The Subcommittee noted that in response to its recommendation, the General Assembly, in resolution 50/27, paragraph 21, had invited Member States to report to the Secretary-General on a regular

basis with regard to national and international research concerning the safety of nuclear-powered satellites. The Subcommittee also noted that the General Assembly, in paragraph 37 of the same resolution, had considered that, to the extent possible, information on the problem of collisions of space objects, including those with nuclear power sources, with space debris, should be provided to the Scientific and Technical Subcommittee, in order to allow it to follow that area more closely. The Subcommittee noted that information had been submitted in response to those requests, as contained in document A/AC.105/619 and Add.1, by Canada, Chile, Germany, Japan and the United Kingdom.

76. The Subcommittee heard scientific and technical presentations on the topic of nuclear power sources by the Russian Federation and the United Kingdom, as described in paragraph 19 of the present report.

77. The Subcommittee took note of the working paper submitted by the United Kingdom on the interpretation and development of safety principles for nuclear power sources in space (A/AC.105/C.1/L.203) and by the Russian Federation on the problem of collisions between nuclear power sources in space and space debris (A/AC.105/C.1/L.204). The Subcommittee also took note of a view that was expressed on the supplementary principles on nuclear power sources in space, as contained in the working paper submitted by the United Kingdom, that further discussions should be held on concepts such as risk justification, maximum tolerable risk, risk reduction and the numerical values related to these, as described in the paper.

78. The Subcommittee agreed that Member States should continue to be invited to report to the Secretary-General on a regular basis with regard to national and international research concerning the safety of space objects with nuclear power sources. The Subcommittee also agreed that further studies should be conducted on the issue of the collision of orbiting space objects with nuclear power sources on board with space debris and that it should be kept informed of the results of such studies.

79. Some delegations expressed the view that in due time supplementary principles might be a way to update the existing Principles Relevant to the Use of Nuclear Power Sources in Outer Space.

80. The view was expressed that the Principles adopted in 1992 were, implicitly, mainly devoted to the protection of the biosphere, as it was the obvious priority goal; that, even if it was premature to review and revise the Principles, it could be recognized that there was a need to add specific chapters devoted to the other aspects; and that, in that spirit, the Subcommittee could assume the duty of identifying and assessing the technical aspects related to the use and management of nuclear power sources on the Moon and other celestial bodies.

81. The Subcommittee recommended that the item be retained on its agenda for the next session and that the time allocated to the topic in both the Working Group and the Subcommittee should be adjusted as appropriate.

V. SPACE DEBRIS

A. General matters

82. In accordance with General Assembly resolution 50/27, the Subcommittee continued its consideration, on a priority basis, of the agenda item on space debris.

83. The Subcommittee agreed that consideration of space debris was important, and that international cooperation was needed to expand appropriate and affordable strategies to minimize the potential impact of space debris on future space missions.

84. The Subcommittee agreed that it could be desirable to compile information on various steps taken by space agencies for reducing the growth or damage potential of space debris and to encourage common acceptance by the international community, on a voluntary basis. The Subcommittee noted with appreciation the report prepared by the Secretariat on this subject (A/AC.105/620), and recommended that it should be updated annually.

85. The Subcommittee took note of the following programmes of Member States and organizations on the acquisition and understanding of data on the characteristics of the space debris environment, and on measuring, modelling and mitigating the orbital debris environment. These programmes include the Material Exposure in Low Earth Orbit (MELEO) experiment and the Advanced Composite Material Exposure Experiment (ACOMEX) of Canada; the Tracking and Image Radar Station (TIRA) of Germany; the Long Duration Exposure Facility (LDEF), the Haystack Orbital Debris Radar, the Orbital Debris Radar Calibration Spheres (ODERACS-1 and 2), the Charged Couple Device (CCD) Debris Telescope and the Liquid Metal Mirror Telescope (LMMT) of the United States; the Communication Research Laboratory (CRL) telescope system and Middle and Upper Atmosphere (MU) radar system of Japan; the various monitoring facilities and analytical models established by the Russian Federation; and the Space Debris Reference Model (MASTER) of ESA .

86. The Subcommittee noted that cooperation continued through the Inter-Agency Space Debris Coordination Committee (IADC), with the participation of Japan, NASA, ESA, and the Russian Space Agency (RSA), and from 1995, the Chinese National Space Agency, to enable its members to exchange information on space debris activities, facilitate opportunities for cooperation in space debris research, review the progress of ongoing activities, and identify debris mitigation options.

87. Recognizing the relevance of the work of IADC and its member agencies to the work of the Subcommittee, the Subcommittee agreed that IADC should be invited to give a presentation at the next session of the Subcommittee.

88. The Subcommittee agreed that Member States should pay more attention to the problem of collisions of space objects, including those with nuclear power sources on board, with space debris, and other aspects of space debris. It noted that the General Assembly, in its resolution 50/27, had called for the continuation of national research on that question, for the development of improved technology for the monitoring of space debris, and for the compilation and dissemination of data on space debris. The Subcommittee recalled the request of the Assembly that information on those issues should be submitted to the Scientific and Technical Subcommittee, and took note of the reports contained in documents A/AC.105/619 and Add.1 submitted to it in accordance with that request. The Subcommittee further agreed that national research on space debris should continue, and that Member States should make the results of that research available to all interested parties.

89. The Subcommittee heard scientific and technical presentations on the subject of space debris by France, Germany, United Kingdom, United States and ESA as mentioned in paragraph 18 of the present report.

90. The Subcommittee took note of the working paper submitted by the Russian Federation on the work done by Russian Federation scientists on the problem of the technogenic pollution of near space (A/AC.105/C.1/L.205).

91. The Subcommittee noted that a certain amount of research on space debris had already been undertaken in some countries, which had allowed for a better understanding of the sources of debris, the areas in near-Earth orbit that were reaching high levels of space debris density, the probabilities and effects of collisions and the necessity of minimizing the creation of space debris. The Subcommittee encouraged Member States and relevant international organizations to provide information on practices that they had adopted, and that had proven effective in minimizing the creation of space debris.

92. The Subcommittee recalled that, in order to advance in its consideration of its agenda item on space debris, it had adopted, at its thirty-second session, a multi-year plan for consideration of space debris. The Subcommittee further recalled that at each session it should review the current operational debris mitigation practices, and consider future mitigation methods with regard to cost efficiency (A/AC.105/605, para. 83).

93. In accordance with the multi-year plan, the Subcommittee, at its current session, had focused its attention on measurements of space debris, understanding of data and effects of this environment on space systems.

B. Technical report of the Subcommittee for 1996

94. In the past several years the scientific and technical community had become concerned about the influence of space debris on the space environment and on the operation of spacecraft. That concern was shared by the Committee on the Peaceful Uses of Outer Space, and, as a consequence, the item on space debris was put on its agenda in 1994. It was agreed that it was important to have a firm scientific and technical basis for future action on the complex attributes of space debris.

95. The Subcommittee agreed to focus on understanding aspects of research related to space debris, including debris measurement techniques; mathematical modelling of the debris environment; characterizing the space debris environment; and measures to mitigate the risks of space debris, including spacecraft design measures to protect against space debris. Accordingly, a multi-year work plan was adopted in 1995 for specific topics to be covered during the time span 1996-1998. It was also agreed that this work plan should be implemented with flexibility, so that all relevant issues on space debris can be addressed. It was understood that space debris are inactive man-made objects, such as spent upper stages, spent satellites, fragments or parts generated during launch or mission operations, or fragments from explosions and other break-ups.

96. This report of the Subcommittee would be structured according to the specific topics addressed by the work plan during the period 1996-1998. The report would be carried forward and updated each year, leading to an accumulation of advice and guidance, in order to establish a common understanding that could serve as the basis for further deliberations of COPUOS on this important matter. The report for 1996 concentrates on the current stage of the multi-year work plan, i.e. measurements of space debris, to be followed in the coming years by the sections on modelling and mitigation. The following chapter of the Technical Report is still subject to possible technical changes and amendments which will be adopted next year.

1. Measurements of space debris

1.1 *Ground-based measurements*

1.1.1 *Radar measurements*

97. Ground-based radars are well suited to observe space objects because of their all-weather and day-and-night performance. However, the radar power budget is a limiting factor for detection of small objects at long ranges.

98. Basically two types of radars are used for space object measurements:

(a) Radars with mechanically controlled beam direction using parabolic reflector antennas. Only objects being in the actual field-of-view - given by the mechanical direction of the parabolic reflector antenna - can be detected and measured;

(b) Radars with electronically controlled beam direction using phased array antennas. Hundreds of objects at different directions can be detected and measured simultaneously.

99. The first type of radar is used mainly for tracking, and the second mainly for search tasks.

100. The following radar modes are used for observation of space debris: tracking mode; beam-park mode; mixed mode; and bistatic mode.

101. In the tracking mode the radar follows an object for a few minutes, gaining data on angular direction, range, range-rate, amplitude and phase of the radar echoes. From the evaluation of direction, speed and range-rate as a function of time, orbital elements can be derived.

102. In the beam-park mode, the antenna is kept fixed in a given direction and echoes are received from objects passing within its field-of-view. This gives statistical information on the number and size of the detected objects, but less precise data on their orbit.

103. In the mixed mode, the radar would start in the beam-park mode and change to the tracking mode when an object passes the beam, thereby gaining more precise orbital data. Once the data are collected, the radar might return to the beam-park mode.

104. In the bistatic mode, an additional receiver antenna, separate from the emitting antenna, is used. This allows a greater sensitivity in the bistatic antenna, which is then able to detect smaller objects.

105. From radar measurements principally, the following space object characteristics can be derived:

(a) Orbital elements describing the motion of the object's centre of mass around the Earth;

(b) Attitude describing the motion of the object around its centre of mass;

(c) Size and shape of the object;

(d) Orbital lifetime;

(e) Ballistic coefficient, as defined in paragraph 127 (f), specifying the rate at which the orbital semi-major axis decays;

(f) Object mass;

(g) Material properties.

106. The deterministic data can go into a catalogue of space objects, as well as the statistical information on numbers of detected objects of a given size in a given region at a certain time.

107. Current radars are able to detect objects larger than 1 centimetre up to a range of 1,000 kilometres or 1 metre in geostationary orbit (GSO). In order to detect smaller objects, the bistatic radar mode has to be adopted. Using this technique, 2-millimetre-sized objects can be detected at ranges of 500 kilometres. These detection ranges apply to highly reflective objects like metals. For other materials, like composites, the reflection of radar signals is weaker.

108. Radar measurements of orbital debris population statistics at sizes below 10 centimetres (the nominal limit for the United States and Russian Federation catalogues) have been conducted by the United States using Haystack and Goldstone radars, and by Germany, using the FGAN radar. Haystack and Goldstone radars have provided a statistical picture of the low Earth orbit (LEO) debris environment at sizes down to 0.5 centimetre (with some data down to 0.2 centimetre. FGAN radar measurements have not extended to quite such small sizes, but in general agree with the NASA results. The picture that emerges from these

measurements is that the debris population exceeds the natural meteoroid population for all sizes larger than about 0.01 centimetre in diameter.

109. The MU radar of Kyoto University of Japan can observe the radar cross-section (RCS) variation of unknown objects for a period of 20 seconds. A bistatic radar system of the Institute of Space and Astronomical Sciences (ISAS) of Japan can detect objects as small as 2 cm at an altitude of 500 kilometres.

1.1.2 *Optical measurements*

110. Optical debris can be detected by reflected sunlight when the debris object is sunlit while the ground below is dark. For objects in LEO, this period is limited to an hour or two just after sunset or before sunrise. However, for objects in high Earth orbit (HEO), such as those in geosynchronous orbit, observations can often be continued during the entire night. The requirement for clear, dark skies is another limitation on optical measurements. An advantage of optical measurements over radar measurements is that the signal intensity from reflected sunlight falls off only as the square of the distance or altitude, whereas the radar signal return falls off as the fourth power of distance. The result is that a telescope of modest size can outperform most radars for detection of debris at extreme altitudes. Some measurement of small debris in LEO have been done using optical telescopes, but in general, radars outperform telescopes for measurements in LEO.

111. The United States Space Command employs 1-metre aperture telescopes fitted with intensified vidicon detectors to track HEO objects. These measurements are used to maintain the HEO part of the Space Command catalogue. The capability of these telescopes is limited to detection of 1-metre objects at geosynchronous altitudes, corresponding to a limiting stellar magnitude of 16. Charge-coupled device (CCD) detectors are planned for these telescopes, which will improve their performance. The Russian Space Agency has a similar telescope capability used to maintain the orbits of HEO objects in their catalogue.

112. In general, the United States Space Command and the Russian Federation catalogues are concerned with intact spacecraft and rocket bodies. However, there are reasons to believe that small orbital debris resulting from explosions also exist in the GSO region. A Russian Federation Ekran satellite in GSO was observed to explode in 1978. During 1986, many uncatalogued objects were seen in high elliptical orbits at an inclination of 7 degrees, possibly the result of an Ariane geotransfer stage breakup. The United States Space Command telescope on Maui, Hawaii accidentally observed the breakup of a Titan 4 transtage (1968-081E) in February 1992. More recently (in February 1994), a Titan 2 transtage (1967-066G) displayed an abrupt orbit discontinuity that indicated that an explosive event had occurred. There are other Titan transtages near GSO that may still have the potential to explode. Some of these stages appear to be lost, and may have exploded.

113. An exceptional combination of sensitivity and field of view is required to survey the GSO region for the small orbital debris that are suspected to exist there. A limiting stellar magnitude of 17 or greater is needed to detect debris smaller than 1 metre near geosynchronous altitude, and as wide a field-of-view as possible is needed to allow rapid survey of large areas. Most astronomical telescopes that have sufficient sensitivity have a small field-of-view. This is useful for accurate determination of satellite positions (once their approximate locations are known), but not for surveying large areas of the sky.

114. Some preliminary measurements have been done to survey the region near GSO for debris objects smaller than 1 metre. NASA used a small telescope capable of detecting objects as faint as 17.1 stellar magnitude (equivalent to an object of about 0.6 metre in diameter at geosynchronous altitude), with a field-of-view of about 1.5 degrees. The results showed that there does exist an appreciable population of debris near these altitudes. Further debris surveys are justified.

115. The existing and planned optical capabilities for optical observation of debris are summarized in table 1 below:

Table 1. Optical facilities for debris observation
(To be completed)

Country	*Organization*	*Telescope aperture (metres)*	*Field-of-view (degrees)*	*Detection type*	*Limiting magnitude*	*Status*
Japan	NAO					
Japan	CRL	1.5				
(Europe)	ESA	1.0		CCD		
United States	NASA	0.3	1.5	CCD	17.1	Operational
United States	NASA	3.0	0.3	CCD	21.5	Development
Switzerland	University of Bern					
United Kingdom	Royal Greenwich Observatory	0.2	0.25	CCD		Operational

1.2 *Space-based measurements*

1.2.1 *Retrieved surfaces and impact detectors*

116. Information on submillimetre-size particles can be gained with the analysis, after return to Earth, of surfaces or spacecraft exposed to the space environment. Similar information can also be obtained through dedicated debris and dust detectors. All of them contain, as a key element, a detection surface. Some of them are designed to catch an impact particle for further analysis. For cost reasons, surfaces are retrieved for later analysis only from LEO.

Examples are given in table 2. below.

Table 2. Examples of retrieved spacecraft and surfaces
(To be completed)

Name	*Orbit*	*In orbit*	*Stabilization*	*Exposed area*
LDEF (NASA)	340-470 km 28.5 degrees	4/84-1/90	Gravity-gradient	151 square metres
EURECA (ESA)	520 km 28.5 degrees	7/92-6/93	Sun-pointing	35 square meters spacecraft + 96 square meters solar arrays
HST Solar Array (NASA/ESA)	610 km 28.5 degrees	5/90-12/93	Sun-pointing	62 squares metres
MIR/EUROMIR 95 (RSA/ESA)	390 km 51.6 degrees	10/95-2/96	Gravity-gradient	20 x 30 cm (cassette)

Name	*Orbit*	*In orbit*	*Stabilization*	*Exposed area*
SFU (JAPAN)	300-500 km 28.5 degrees	3/95-1/96	Sun-pointing	150 square metres (including solar arrays)
Space Shuttle (NASA) Orbiter	300-500 km 28.5 degrees, 51.6 degrees	1992-present	various	100 square metres

117. After exposure to the space environment, spacecraft surfaces are covered with a large number of impacts of meteoroids and debris. The size of individual impact craters and holes extends from micrometres to several millimetres. A basic problem is to distinguish between impacts of meteoroids and man-made debris. A proven method to determine their origin is chemical analysis. However, there are some difficulties associated with this method. Because of the high impact speed, little of the impacting material survives unaltered. The particle vaporizes and then recondenses on the surrounding surfaces. In many cases the origin of an impacting particle cannot be uniquely determined (lack of residue or chemical analysis not conclusive). In order to relate the size of the impact feature with the size of the particle, ground-calibration tests (hypervelocity impact tests) have been performed for different materials.

118. From impact statistics and calibration experiments, the flux for meteoroids and debris can be determined as a function of particle size. An important issue to be considered is that of secondary impacts. If these are not properly treated, the derived flux figures will be overestimated.

119. LDEF was covered by more than 30,000 craters visible to the naked eye, of which 5,000 had a diameter larger than 0.5 millimetre. The largest crater of 5 millimetres in diameter was probably caused by a 1 millimetre particle. The LDEF showed that some impacts were clustered in time, and it also points to the existence of a submillimetre population in elliptical orbits.

120. On EURECA the largest impact crater diameter was 6.4 millimetres. Among the retrieved surfaces, the returned solar array of the Hubble Space Telescope (HST) had been the one with the highest orbit altitude. An interesting finding was that the impact flux for HST was considerably higher (factor 2-8) than for EURECA for crater pit sizes larger than 200-300 microns.

121. The Space Flyer Unit (SFU) launched in March 1995 was retrieved by the Space Shuttle in January 1996. A planned post-flight analysis (PFA) is expected.

122. In general, observed flux figures agree roughly with model predictions.

123. The cases discussed above give evidence of the effect of the particulate environment on spacecraft in orbit. In all cases no functional degradation of the spacecraft was observed. Available information on the submillimetre population is limited to altitudes below 600 kilometres. In particular, no information is available in the regions of highest density of space debris in LEO (at an altitude of about 800-1000 kilometres) as well as in the geostationary orbit. However, ESA will place a debris and dust detector in the geostationary orbit.

1.2.2 *Radar and optical measurements from space*

124. Space-based measurements in general have the advantage of higher resolution because of the smaller distance between the observer and object. Also, there is no disturbing effect of the atmosphere (extinction

and absorption of electromagnetic signals). Obviously, costs of space-based systems are in general higher than those on ground, and careful cost-performance trade-offs are needed.

1.2.3 *Infrared measurements from space*

125. The infrared astronomical satellite IRAS, launched in 1983 to perform a sky survey at wavelengths ranging from 8 to 120 micrometres, was operational during the 10 months in a sun synchronous orbit near an altitude of 900 kilometres. The satellite was pointing radially away from Earth and scanning the celestial sphere. The complete set of unprocessed IRAS data has been analysed by the Space Research Organization of the Netherlands (SRON), Groningen, in order to characterize the infrared emission of debris objects and to extract a comprehensive set of debris sightings. The method of identifying space debris signatures is based on the recognition of their track over the IRAS focal plane. The 200,000 potential debris sightings are stored in a database. About 10,000 sightings are attributed to real objects. From the debris sightings, it is not possible to compute the orbital elements of a debris object in a unique manner.

1.3 *Cataloguing and databases*

126. A catalogue is a deterministic record of the characteristics of the orbital population that have been derived from measurements or records. The purposes of a catalogue are to provide correlation with observations of orbiting objects; to act as a historical record of orbital activity for the purposes of environment monitoring; to serve as an input to modelling the behaviour of orbiting objects; and to provide a basis for predicting future launch and operational activity.

127. The following characteristics of orbiting objects are recorded:

(a) Mass: the launch mass, beginning of life mass and dry mass (end of life);

(b) Radar cross-section: the returned signature of an orbiting object from which shape, orientation and size can be derived;

(c) Albedo: a measure of the reflectivity of an object which characterizes the optical visibility of an object;

(d) Dimensions;

(e) Orientation;

(f) Ballistic coefficient: a measure of the aerodynamic and mass-geometric characteristics of the object which will influence the orbital lifetime of an object until its entry into the upper atmosphere;

(g) Material construction: although not currently of importance, to effectively represent shedding of micro-debris would require the definition of surface characteristics;

(h) State vectors: the characteristics of the orbit of an object derived at a particular instant in time;

(i) Launch characteristics: this will include the launch vehicle, launch date and launch site.

128. There are two catalogues of space objects which are frequently updated by observations: the United States Space Command catalogue; and the Russian Federation space object catalogue. The data from these two catalogues are archived in the DISCOS database of ESA, which also contains other relevant information.

129. NASDA is also studying the possibility of a debris database, as well as the provision of data to the international debris database discussed at IADC, and prediction of time and location of the re-entry of debris objects and the Collision Avoidance analysis for new launches.

130. NASDA currently depends on the United States Space Command orbital element data as its source-of-debris database. NASDA will add the orbital data of debris acquired through its own experiments and satellites to that data.

131. A catalogue record can be stored through a number of media. A hard copy (paper) format is not well suited to the dynamic nature of the orbital population. An electronic format is well suited to the recording of such information; modification and updating of characteristics; manipulation of data for the purposes of comparison and input to models; and global access via networks by global users for the purposes of interrogation and contribution.

1.4 *Effects of the space debris environment on the operation of space systems*

132. Four factors determine how the space debris environment affects space systems operations. These are time in orbit, projected area, orbital altitude and orbital inclination. Of these, time in orbit, projected area and orbital altitude are the dominant factors.

1.4.1 *Effects of large debris objects on the operation of space systems*

133. Large debris objects are typically defined as objects larger than 10 centimetres in size. Such objects are capable of being tracked, and orbital elements are maintained. During the course of shuttle missions, orbiters have been required to execute collision avoidance manoeuvres in order to avoid catastrophic collisions with these large debris objects.

1.4.2 *Effects of small debris objects on the operation of space systems*

134. To date, small debris objects (smaller than a few millimetres in diameter) have caused damage to operational space systems. This damage can be divided into two categories. The first category is damage to surfaces or subsystems. The second category is the effect on operations.

1.4.2.1 *Damage to surface or subsystems*

135. Examples of damage that affect the surface of operational systems are:

(a) Damage to shuttle windows;

(b) Damage to the Hubble Space Telescope (HST) high gain antenna;

(c) Severing of the Small Expendable Deployer System - 2 (SEDS-2) tether;

(d) Damage to other exposed shuttle surfaces.

1.4.2.2 *Effects of space debris on manned space operations*

136. In order to protect crews from debris during flight, operational procedures have been adopted. In the case of the space shuttle, the orbiter is oriented during flight with the tail pointed in the direction of the velocity vector. This flight orientation was adopted to protect the crew and sensitive orbiter systems from damage caused by collisions with small debris.

137. Operational restrictions have also been adopted for extravehicular activities (EVAs). Whenever possible, EVAs are conducted in such a way as to ensure that the EVA crew is shielded from debris by the orbiter.

138. *The following sections are to be completed at the next two sessions of the Scientific and Technical Subcommittee:*

2. Modelling of space debris environment and risk assessment

2.1 *Methods of modelling of the debris environment*

2.1.1 *Spatial distribution and its time evolution*

2.1.2 *Collision probabilities*

2.1.3 *Effects of collisions*

2.2 *Comparison of the results of short-term and long-term models*

3. Space debris mitigation measures

3.1 *Reduction of the debris increase in time*

3.1.1 *Avoidance of mission-related objects*

3.1.2 *Improving structural integrity of space objects (explosion prevention etc.)*

3.1.3 *De-orbiting and reorbiting of space objects*

3.2 *Protection strategies*

3.2.1 *Shielding*

3.2.2 *Collision avoidance*

3.3 *Effectiveness of mitigation measures*

C. General views

139. Some delegations expressed the view that every user of the geostationary orbit should plan to remove its space object from the orbit after its work was completed, and thereby eliminate a source of danger to other users of outer space.

140. The view was expressed that an international centre could be established with the aim of providing information and advance warning on explosions in space, fragmentation of space objects and possible collision of space objects with space debris. In this regard, that delegation also expressed the view that international cooperation should be encouraged, with regard to the exchange of catalogues of space objects, the computation of dangerous encounters of catalogued objects with spacecraft and the observation of objects in the GSO. That delegation also believed that a uniform database from existing catalogues and a universal format for data exchange should be established.

141. Some delegations were of the view that the Legal Subcommittee should be informed of the discussions in the Scientific and Technical Subcommittee under the agenda item on space debris. The view was also expressed that a set of international rules for the launch of spacecraft should be codified, based on current practices of space agencies, in order to reduce the growth of orbital debris.

142. Other delegations expressed the view that it would not be appropriate to discuss the issue of space debris in the Legal Subcommittee or to develop recommendations in the Scientific and Technical Subcommittee to underpin new legal norms for orbital debris in view of the many technical issues that still need to be discussed by the Scientific and Technical Subcommittee.

143. The view was expressed that the Subcommittee should establish a working group to discuss space debris, and that it was important for the Subcommittee to have a common understanding of the term "space debris". In this regard, the view was expressed that the definition proposed at the previous session of the Subcommittee (A/AC.105/605, para. 95) could be modified to include the words "whether their owners can be identified or not" after the words "including their fragments and parts" so that the definition would now read as follows: Space debris are all man-made objects, including their fragments and parts, whether their owners can be identified or not, in Earth orbit or re-entering the dense layers of the atmosphere that are non-functional with no reasonable expectation of their being able to assume or resume their intended functions or any other functions for which they are or can be authorized. The view was expressed that further specification in the definition of space debris would deserve expert consideration at the next session of the subcommittee.

144. The Subcommittee recommended that the item be retained on its agenda as a priority item for its next session.

VI. QUESTIONS RELATING TO SPACE TRANSPORTATION SYSTEMS AND THEIR IMPLICATIONS FOR FUTURE ACTIVITIES IN SPACE

145. In accordance with General Assembly resolution 50/27, the Subcommittee continued its consideration of the item relating to space transportation systems.

146. In the course of the discussion, delegations reviewed national and international cooperative programmes in space transportation systems, including expendable launchers, reusable space shuttles and space stations. In particular, the Committee noted that China was continuing the use and development of its Long March series of launch vehicles; that India was continuing development of the Geostationary Satellite Launch Vehicle and had succeeded in the developmental launch of the Polar Satellite Launch Vehicle; that Japan had introduced into service its H-II launch vehicle, had successfully launched the J-1 launch vehicle and was continuing its development of the H-IIA and M-V launch vehicles; that the Russian Federation had launched space objects of various types using expendable launchers of the Soyuz, Cosmos, Proton and other series and had sent a number of national and international crews to the Mir space station; that Ukraine, in cooperation with the Russian Federation, was continuing to produce and successfully use the Tsyklon and Zenit rocket launchers, as well as offering them for use in international cooperative activities; that the United Kingdom was cooperating with ESA in its Future European Space Transportation Investigation Programme (FESTIP); that the United States was continuing its programme of expendable launches and flights of the reusable Space Shuttle, many of the flights involving significant international participation; that Canada, Japan, Russian Federation, United States and ESA were continuing preparations on the International Space Station programme; and that ESA was continuing development of the Ariane series of launch vehicles.

147. The Subcommittee took note of developments in the United States commercial launch industry, including the Atlas, Delta and Pegasus expendable vehicles, and the Reusable Launch Vehicle technology programme that included the X-33 experimental launch vehicle. In that connection, the Subcommittee noted that the results of that programme would be used to assess the feasibility and affordability of a new

generation of reusable launch systems. The Subcommittee also took note of the Automatic Landing Flight Experiment (ALFLEX) and study of the HOPE-X experimental unmanned winged vehicle of Japan.

148. The Subcommittee took note of developments in the Russian Federation, including the improved Proton-M launcher, the ecologically clean Rus and Angara launchers and the airborne launched systems, Burlak and Aerokosmos. The Subcommittee also took note of the introduction into the space transportation system of the Russian Federation of the Start-1, Start and Rokot launchers that were based on converted ballistic missiles. The Subcommittee further noted that in addition to the Plesetsk cosmodrome that had seen almost 1,500 launches during the previous 30 years, there were plans for the construction of a new cosmodrome called Svobodny in the eastern part of the country.

149. The Subcommittee stressed the importance of international cooperation in space transportation in order to provide all countries with access to the benefits of space science and technology.

150. The Subcommittee was informed of the concept of the X-Prize, a prize that would promote private industry development of a reusable, single-stage, sub-orbital vehicle capable of carrying three persons (300 kilograms) to an altitude of at least 100 kilometres above Earth, and which would stimulate public interest in space exploration and development and lead to the capability to fly many people into space, as reflected in the resolution adopted unanimously by ASE.

151. The view was expressed that the United Nations should undertake a study to determine the feasibility of it becoming the organization responsible for administering the launching, placement into orbit and utilization of satellites for educational and investigative institutions.

152. The Subcommittee recommended that consideration of the item be continued at its next session.

VII. EXAMINATION OF THE PHYSICAL NATURE AND TECHNICAL ATTRIBUTES OF THE GEOSTATIONARY ORBIT; EXAMINATION OF ITS UTILIZATION AND APPLICATIONS, INCLUDING, *INTER ALIA*, IN THE FIELD OF SPACE COMMUNICATIONS, AS WELL AS OTHER QUESTIONS RELATING TO SPACE COMMUNICATIONS DEVELOPMENTS, TAKING PARTICULAR ACCOUNT OF THE NEEDS AND INTERESTS OF DEVELOPING COUNTRIES

153. In accordance with General Assembly resolution 50/27, the Subcommittee continued its consideration of the item relating to the geostationary orbit and space communications.

154. In the course of the discussion, delegations reviewed national and international cooperative programmes in satellite communications, including progress in communications satellite technology that would make satellite communications more accessible and less expensive and increase the communications capacity of the geostationary orbit and the electromagnetic spectrum.

155. The Subcommittee took note of the growing use of communications satellite systems for telecommunications, television broadcasting, data networks, environmental data relay, mobile communications, disaster warning and relief, telemedicine and other communications functions.

156. Some delegations expressed the view that the geostationary orbit was a limited natural resource and that saturation should be avoided in order to ensure that all countries had non-discriminatory access to the orbit. Those delegations felt that a special *sui generis* legal regime was required to ensure equitable access by all States, particularly developing countries. They felt that the role of ITU, which concerned the technical

aspects, and of the Committee on the Peaceful Uses of Outer Space with respect to the geostationary orbit were complementary. Other delegations expressed the view that questions relating to the geostationary orbit were being addressed effectively by ITU.

157. The view was expressed that in considering the question of equitable access, account should be taken in particular of the geographic situation of the equatorial countries. The view was also expressed that a geostationary satellite, like all other satellites, was attracted by the entire body of the Earth and that, therefore, it could not be said that the phenomenon of a geostationary satellite was linked to gravitational phenomena produced uniquely in the plane of the terrestrial equator.

158. The view was expressed that the Subcommittee could undertake a technical study on alternatives for determining and assigning orbits in the geostationary and other orbits, not only for communications purposes, and that one such alternative could be binding the geostationary orbit to an international trust fund that would have all Member States of the United Nations as beneficiaries.

159. Some delegations noted that the use of the geostationary orbit, like other orbits, was affected by the problem of space debris and that efforts were needed to minimize the generation of debris in the orbit and to move satellites shortly before the end of their useful lives into disposal orbits beyond the geostationary orbit.

160. The Subcommittee recommended that consideration of the item relating to the geostationary orbit and space communications be continued at its next session.

VIII. PROGRESS IN NATIONAL AND INTERNATIONAL SPACE ACTIVITIES RELATED TO THE EARTH ENVIRONMENT, IN PARTICULAR PROGRESS IN THE GEOSPHERE-BIOSPHERE (GLOBAL CHANGE) PROGRAMME

161. In accordance with General Assembly resolution 50/27, the Subcommittee continued its consideration of the item concerning progress in national and international space activities related to the Earth environment, in particular progress in the Global Change Programme.

162. The Subcommittee noted the progress being made through international cooperation in the Global Change Programme, with the participation of many countries. It noted that such a joint international effort was of fundamental importance for examining the future habitability of the planet and for managing the common natural resources of the Earth. The Subcommittee took particular note of the need to involve as many countries as possible in the scientific activities of the Programme, both in developed and in developing countries.

163. The Subcommittee took note of the important contributions of satellite remote sensing for environmental monitoring, for planning sustainable development, for water-resource development, for monitoring crop conditions, and for predicting and assessing drought. The Subcommittee also noted the progress made in India in the field of climate modelling, monsoon dynamics, atmospheric chemistry and radiation, and land, air and ocean interaction.

164. The Subcommittee noted the important contribution of meteorological and atmospheric research satellites for studying global climate change, the greenhouse effect, the degradation of the ozone layer and other global environmental processes. The previously launched Topex/Poseidon oceanographic satellite, Upper Atmosphere Research Satellite, CRISTA-SPAS, SAR, Third Atmospheric Laboratory for Applications and Science (ATLAS-3), Total Ozone Mapping System, RADARSAT, Earth Resources Satellite 1 and 2, Marine

Observation Satellite (MOS), the IRS series of satellites, and Sich 1 satellite were important tools for that purpose, as would be the planned Phase II Mission to Planet Earth, Earth Observing System (EOS) series of spacecraft, TRMM, Envisat, ADEOS, Meteor, Meteosat and other similar spacecraft. The Subcommittee noted the need for further space research relating to climate change, weather patterns, vegetation distribution, storm and flood risk, and other environmental factors.

165. The Subcommittee noted the importance of international cooperation in the various existing and planned satellite systems for environmental monitoring. It recommended that other States consider participating in such cooperative activities.

166. The Subcommittee recommended that consideration of the item be continued at its next session.

IX. MATTERS RELATING TO LIFE SCIENCES, INCLUDING SPACE MEDICINE

167. In accordance with General Assembly resolution 50/27, the Subcommittee continued its consideration of the item relating to life sciences.

168. The Subcommittee recalled that the General Assembly, in its resolution 50/27, had considered it particularly important that all countries should have the opportunity to use the techniques resulting from medical studies in space.

169. The Subcommittee noted that studies of human and animal physiology under the microgravity conditions of space flight had led to important advances in medical knowledge in such areas as blood circulation, sensory perception, immunology and the effects of cosmic radiation. It noted that important new information in those fields had been obtained through experiments on the Mir space station, particularly during the joint ESA-Russian Federation long-duration EUROMIR '95 mission, during the first long-duration flight of a woman cosmonaut, during the first flight of a United States astronaut aboard the Mir space station and during two docking missions of the United States Space Shuttle with the Mir space station. Important data were gathered during several United States Space Shuttle missions, in particular during the Second United States Microgravity Laboratory mission. Other important data were also gathered from biological experiments on the sounding rocket MAXUS and the newly equipped DC-9 microgravity research aircraft.

170. The Subcommittee took note of forthcoming flights of the Space Shuttle with Canadian national life sciences payloads, as well as two Canadian astronauts among its crews, of preparations for the first Chilean biomedical experiment on the Space Shuttle and of a bilateral German-Russian cooperation project, MIR '96, which would take advantage of this long-duration manned mission for experiments focusing on human physiology, materials sciences and technology. It also noted the French-German cooperation in the development of a diagnostic facility for cardiovascular research in space, CARDIOLAB, to be used on the International Space Station, and the development by the space agencies of Bulgaria, Germany and the Russian Federation of a new generation of medical measuring equipment, NEUROLAB, as well as the Bulgarian automatic biotechnological system SVET.

171. The Subcommittee noted that applications of space technologies were demonstrating growing promise in medicine and public health on Earth. In that connection, the Subcommittee noted that specialists from Portugal had studied a new "vibration disease" that occurred after prolonged stays in specific industrial, aeronautical and spatial environments. The Subcommittee also noted that products of space biotechnology, such as pharmaceutical and medical instruments, could contribute to improved health care. The Subcommittee noted the importance of space technology for those purposes and encouraged further research and exchange of information on those applications.

172. The Subcommittee noted that space studies in life sciences and medicine had important potential benefits for all countries and that efforts should be made to promote international cooperation to enable all countries to benefit from those advances.

173. The Subcommittee recommended that consideration of the item be continued at its next session.

X. MATTERS RELATING TO PLANETARY EXPLORATION AND MATTERS RELATING TO ASTRONOMY

174. In accordance with General Assembly resolution 50/27, the Subcommittee continued its consideration of the item on planetary exploration and the item on astronomy.

175. The Subcommittee noted that several planetary exploration missions were currently under way. The Galileo spacecraft successfully entered into orbit around Jupiter and sent its instrumented probe into the atmosphere of Jupiter. The ESA Ulysses spacecraft, following its swing-by trajectory from Jupiter, was studying the solar polar regions that had not been previously investigated. The Subcommittee noted missions planned for future launch, including Mars 96, Planet B, Mars Surveyor, Orbiter and Pathfinder, for investigation of Mars; Lunar Prospector for lunar exploration; Cassini/Huygens, for investigation of Saturn and its moons; and the Near-Earth Asteroid Rendezvous (NEAR), Stardust and Rosetta missions to asteroids and comets. The Subcommittee noted the high degree of international cooperation in all of those investigations, and stressed the need to further enhance international cooperation in planetary exploration to enable all countries to benefit from and participate in those activities.

176. The Subcommittee noted that the use of spacecraft for making astronomical observations from above the atmosphere had greatly advanced knowledge of the universe by allowing observations in all regions of the electromagnetic spectrum. It noted that with the repaired Hubble Space Telescope, Stretched Rohini Scientific Satellite (SROSS C-2), Rosat, Granat and Roentgen-Kvant X-ray observatories, Compton Gamma Ray Observatory, Extreme Ultraviolet Explorer, Astro-D, Freja, Koronas I and Wind satellites, and with data from the recent Interball, Infrared Space Observatory, Solar and Heliospheric Observatory and X-Ray Timing Explorer, as well as the Spartan series of subsatellites, astronomers had powerful tools for their investigations of the universe. The planned launches of the four Cluster satellites, Radioastron satellite, Spektr-Roentgen-Gamma observatory, ASTRO-SPAS subsatellites, Advanced X-ray Astrophysics Facility, Space Infrared Telescope Facility, Spektr-UV, International Gamma Ray Astronomy Laboratory (INTEGRAL), Scientific Applications Satellite (SAC-B), Very Long Base Interferometry Space Observatory, X-ray Multi-Mirror Mission (XMM), Gamma 1 and 400, Ikon, Relikt 3 and many others would open up further realms of the universe to detailed observation. The Subcommittee also took note of ground-based astronomical observations, in particular those by the new radiotelescope built in Turkey in cooperation with Ukraine. The Subcommittee noted with satisfaction that all of those projects were open to broad international cooperation. The Subcommittee heard a special presentation of the report on the international conference on near-Earth objects, and a presentation by IAU on solar reflectors, radio astronomy and access to the sky, as described in paragraph 19 of the present report.

177. The Subcommittee recommended that consideration of the items be continued at its next session.

XI. THE THEME FIXED FOR SPECIAL ATTENTION AT THE 1996 SESSION: UTILIZATION OF MICRO- AND SMALL SATELLITES FOR THE EXPANSION OF LOW-COST SPACE ACTIVITIES, TAKING INTO ACCOUNT THE SPECIAL NEEDS OF DEVELOPING COUNTRIES

178. In accordance with General Assembly resolution 50/27, the Subcommittee paid special attention to the theme "Utilization of micro- and small satellites for the expansion of low-cost space activities, taking into

account the special needs of developing countries". The Subcommittee noted with satisfaction that, at its invitation, COSPAR and IAF had organized a symposium on the theme on 12 and 13 February 1996, as described in paragraphs 16 and 17 of the present report.

179. The Subcommittee also heard special presentations on the special theme by Poland and the Russian Federation as described in paragraph 19 of the present report.

180. The Subcommittee took note of the fact that as a consequence of the evolution of space-related technologies, in particular microelectronics, power generation and storage, as well as in propulsion technology, micro- and small satellites could make significant space capabilities accessible to a wide range of users, including students in secondary schools and universities and engineers and scientists in many countries. It was also noted that small satellite projects are ideal for extensive international cooperation, as relatively sophisticated scientific and technological experiments as well as application missions could be flown in space at modest costs. In this regard, the Subcommittee noted particular application areas including space physics, astronomy, astrophysics, technology demonstrations, communications and data relay experiments, and acquisition of Earth resource data, including disaster-related information.

181. The Subcommittee also noted that small satellites represent an excellent method for training students, engineers and scientists in different disciplines, including engineering, software development for on-board and ground computers and management of sophisticated technical programmes. Among the main difficulties in promoting the use of small satellite technology for developing countries, the Subcommittee noted a low awareness of policy-making officials and the general public of the importance and benefits of a national space programme, as well as a lack of adequately trained local personnel.

182. On the basis of the results of its deliberations on this special theme as well as the recommendations contained in the technical study on microsatellites and small satellites (A/AC.105/611), the Subcommittee recommended that more of the activities of the Programme on Space Applications should be devoted to this theme.

XII. OTHER MATTERS

A. Third UNISPACE conference

183. The Subcommittee noted that the General Assembly, in its resolution 50/27, paragraph 32, had agreed that a Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space could be convened before the turn of the present century, and that, prior to recommending a date for the Conference, there should be a consensus recommendation on the agenda, venue and funding of the Conference.

184. The Scientific and Technical Subcommittee noted that the General Assembly, in paragraph 33 of the same resolution, had recommended that the Subcommittee continue the work it had conducted at its thirty-second session, taking into particular account the report of its Working Group of the Whole (A/AC.105/605, annex II), with the aim being to complete the development and refinement of a framework that would allow an evaluation of proposals by the Committee at its thirty-ninth session, and that this framework should allow for the consideration of all possibilities of achieving the final objectives of such a Conference. The Subcommittee also noted the agreement of the General Assembly, in paragraph 34 of the same resolution, that on the basis of the work to be conducted at the thirty-third session of the Scientific and Technical Subcommittee, the Committee, at its thirty-ninth session, should consider all issues related to the possible convening of a third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, including its technical and political objectives, a detailed and sharply focused agenda, funding, timing and other organizational aspects as well as whether the objectives of the conference could be achieved by other means, with a view to making a final recommendation to the General Assembly at that session of the Committee.

185. The Subcommittee, through its Working Group of the Whole, carried out the tasks entrusted to it by the General Assembly. The Subcommittee, in adopting the report of the Working Group, noted the views of the Working Group of the Whole as outlined in its report, contained in annex II to the present report. In adopting the report, the Subcommittee agreed that the report of the Working Group provided the basis for the Committee to carry out the task entrusted to it by the General Assembly.

186. Some delegations considered that the various proposals in the report and appendices of the Working Group of the Whole demonstrated a general move towards consensus based on an event of restricted duration and scope that could cover the objectives discussed, and expressed the view that consensus could be reached by continuing the discussions that had proceeded so well in the Subcommittee. Those delegations also considered that in considering the proposals, the Committee should note that no discussion on a venue had taken place, and that the idea of an event that had a duration of no longer than one week was supported by the majority of delegations.

B. Other reports

187. The Subcommittee welcomed the annual reports of ITU (A/AC.105/634), WMO (A/AC.105/633), EUMETSAT (A/AC.105/629), EUTELSAT (A/AC.105/627), INTELSAT (A/AC.105/626) and INTERSPUTNIK (A/AC.105/628). The Subcommittee requested those organizations to continue to report on their work.

188. The Subcommittee expressed its appreciation to COSPAR for its report on the progress of space research and to IAF for its report on space technology and applications, the two reports issued jointly under the title "Highlights in space: Progress in space science, technology and applications, international cooperation and space law, 1995" (A/AC.105/618).

189. The Subcommittee noted with appreciation the participation in its session of representatives from United Nations bodies, specialized agencies and permanent observers, and found their statements and reports helpful in enabling the Subcommittee to fulfil its role as focal point for international cooperation in space.

190. The Subcommittee had before it document A/AC.105/C.1/1996/CRP.4 containing the medium-term plan proposed by the Office for Outer Space Affairs for the period 1998-2001.

C. Review of the future role and work of the Scientific and Technical Subcommittee

191. The Subcommittee recommended that the agenda of its thirty-fourth session should include the following priority items:

(a) Consideration of the United Nations Programme on Space Applications and the coordination of space activities within the United Nations system;

(b) Implementation of the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space;

(c) Matters relating to remote sensing of the Earth by satellites including, *inter alia*, applications for developing countries;

(d) Use of nuclear power sources in outer space;

(e) Space debris.

192. The Subcommittee recommended that the agenda of its thirty-fourth session should also include the following items:

(a) Questions relating to space transportation systems and their implications for future activities in space;

(b) Examination of the physical nature and technical attributes of the geostationary orbit and of its utilization and applications, including, *inter alia*, in the field of space communications, as well as other questions relating to space communications developments, taking particular account of the needs and interests of developing countries;

(c) Matters relating to life sciences, including space medicine;

(d) Progress in national and international space activities related to the Earth environment, in particular progress in the International Geosphere-Biosphere (Global Change) Programme;

(e) Matters relating to planetary exploration;

(f) Matters relating to astronomy;

(g) Consideration of the theme fixed for special attention at the thirty-fourth session of the Scientific and Technical Subcommittee: "Space systems for direct broadcasting and global information systems".

193. The Subcommittee recommended that, regarding agenda item (g) in paragraph 192 above, COSPAR and IAF, in liaison with Member States, should be invited to arrange a symposium, with as wide a participation as possible, to be held during the first week of the thirty-fourth session, to complement discussions by the Subcommittee on the special theme.

194. With regard to the dates for the thirty-fourth session, the Subcommittee recommended that it be scheduled from 17 to 28 February 1997.

D. Working methods of the Subcommittee

195. Some delegations noted that the Chairman of the Group of 77, speaking on behalf of the Group of 77, while expressing satisfaction with the election of the present Chairman under agenda item 1, had also expressed the view that the principles of rotation, equitable representation of the various geographical regions and transparency of the office of the Committee and its subsidiary bodies should prevail in future election, as was the case in other bodies in the United Nations system.

196. Some delegations were of the view that discussions on the working methods of the Subcommittee should be continued in the Committee with a view to changing the term and composition of its bureau to include a Vice-Chairman and a Rapporteur, as well as considering the possibility of rotation of the chairmanship of the Subcommittee. The view was also expressed that the statement of the Chairman could be delivered and the general exchange of views could take place in conjunction with the consideration of items 5 and 6 on the current agenda of the Subcommittee. Other delegations were of the view that the statement of the Chairman and the general exchange of views should be retained on the agenda of the Subcommittee, as the statement of the Chairman allowed him the opportunity to comment on the state of the Subcommittee, and the general exchange of views provided all States members of the Subcommittee with the opportunity for initial comment on issues and activities of relevance to the Subcommittee in advance of statements on more specific agenda items. Those delegations were also of the view that the current practices of the bureau of the Subcommittee were satisfactory, and that there was no need to define the term and composition of the bureau.

197. The Subcommittee agreed that progress had been made in improving the working methods of the Subcommittee. It recommended that the Committee should give due consideration to the views expressed by delegations on this subject in performing its task of further improving the working methods of the Committee and its subcommittees.

E. Commemoration

198. The Subcommittee took note of the thirty-fifth anniversary of the first human space flight executed on 12 April 1961 by the cosmonaut Yuri Gagarin of the former Union of Soviet Socialist Republics.

Notes

[1]*Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992* (A/CONF.151/26/Rev.1 (Vol. I and Vol. I/Corr.1, Vol. II, Vol. III and Vol. III/Corr.1)) (United Nations publication, Sales No. E.93.1.8 and corrigenda), vol. 1: *Resolutions Adopted by the Conference*, resolution 1, annex II.

Annex I

DOCUMENTS BEFORE THE SCIENTIFIC AND TECHNICAL SUBCOMMITTEE AT ITS THIRTY-THIRD SESSION

Item 2 - Adoption of the agenda

A/AC.105/C.1/L.202 Provisional agenda, with annotations, for the thirty-third session

Item 5 - United Nations Programme on Space Applications and the coordination of space activities within the United Nations system

Item 6 - Implementation of the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space

A/AC.105/625 Report of the United Nations Expert on Space Applications

A/AC.105/610 Report of the United Nations/European Space Agency Workshop on Applications of Space Technologies to Prevent and Combat Natural Disasters, organized in cooperation with the Government of Zimbabwe (Harare, 22-26 May 1995)

A/AC.105/612 Report of the United Nations/International Astronautical Federation Workshop on Space Technology for Health Care and Environmental Monitoring in the Developing World, co-sponsored by the European Space Agency, the Commission of the European Communities and the Government of Norway and hosted by the Norwegian Space Centre (Oslo, 28 September-1 October 1995)

A/AC.105/613 Report of the United Nations/European Space Agency Training Course on the Use of ERS-1 Data for the Mapping and Inventory of Natural Resources in Africa (Libreville, Gabon, 15-19 May 1995)

A/AC.105/615 Report on the United Nations/European Space Agency Symposium on Space Technology for Improving Life on Earth, co-sponsored by the Commission of the European Communities, the European Space Agency and the Government of Austria (Graz, Austria, 11-14 September 1995)

A/AC.105/616 United Nations/Sweden Annual Course Series on Remote Sensing Education for Educators, Impact of 1990, 1992 and 1993 Courses

A/AC.105/617 Report on the Fifth United Nations International Training Course on Remote Sensing Education for Educators, held in cooperation with the Government of Sweden (Stockholm and Kiruna, Sweden, 2 May-9 June 1995)

A/AC.105/621 Seminars of the United Nations Programme on Space Applications: Selected papers on remote sensing, satellite communications and space science, 1996

A/AC.105/622 UN/ESA Regional Conference on Space Technology for Sustainable Development and Communications (Puerto Vallarta, Mexico, 30 October-3 November 1995)

A/AC.105/623	UN/ESA International Training Course for Asia and the Pacific Countries on the Applications of ERS-1 Data for Natural Resources, Renewable Energy and the Environment (Frascati, Italy, 13-25 November 1995)
A/AC.105/624	UN/ICTP Workshop on Optics in Space Science and Technology (Trieste, Italy, 20-25 November 1995)
A/AC.105/630	Report of the Inter-Agency Meeting on Outer Space Activities (United Nations Office at Vienna, 7-9 February 1996)
A/AC.105/631	Coordination of outer space activities within the United Nations system: Programmes of work for 1996 and 1997 and future years
A/AC.105/611	Microsatellites and small satellites: Current projects and future perspectives for international cooperation
A/AC.105/632	Use of remote sensing technologies for environmental applications, particularly in support of the recommendations of the United Nations Conference on Environment and Development
A/AC.105/614 and Add 1, 2, 3	Implementation of the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space: International cooperation in the peaceful uses of outer space: activities of Member States

Item 8 - Use of nuclear power sources in outer space

Item 9 - Space debris

A/AC.105/619 and Add.1	National research on space debris: safety of nuclear-powered satellites: Problems of collisions of nuclear power sources with space debris
A/AC.105/620	Steps taken by space agencies for reducing the growth or damage potential of space debris

Item 17 - Other matters

A/AC.105/618	Highlights in space: Progress in space science, technology and applications, international cooperation and space law, 1995
A/AC.105/626	Report of the International Telecommunications Satellite Organization
A/AC.105/627	Report of the European Telecommunications Satellite Organization
A/AC.105/628	Report of "INTERSPUTNIK"
A/AC.105/629	Report of the European Organization for the Exploitation of Meteorological Satellites
A/AC.105/633	Report of the World Meteorological Organization
A/AC.105/634	Report of the International Telecommunication Union

Working Group of the Whole to Evaluate the Implementation of the Recommendations of UNISPACE 82

A/AC.105/C.1/WG.6/L.11 and Add.1	Draft report of the Working Group of the Whole to Evaluate the Implementation of the Recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space on the work of its ninth session

Annex II

REPORT OF THE WORKING GROUP OF THE WHOLE TO EVALUATE THE IMPLEMENTATION OF THE RECOMMENDATIONS OF THE SECOND UNITED NATIONS CONFERENCE ON THE EXPLORATION AND PEACEFUL USES OF OUTER SPACE ON THE WORK OF ITS TENTH SESSION

1. The Working Group of the Whole to Evaluate the Implementation of the Recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82) was re-established for its tenth session by the Scientific and Technical Subcommittee in accordance with General Assembly resolution 50/27, paragraph 19, of 6 December 1995, with a view to improving the execution of activities relating to international cooperation, particularly those included in the United Nations Programme on Space Applications, and to proposing concrete steps to increase such cooperation as well as to make it more efficient. The Working Group held a series of meetings from 14 to 22 February 1996, during the thirty-third session of the Scientific and Technical Subcommittee. At its meeting on 22 February 1996, the Working Group adopted the present report.

2. Mr. Muhammad Nasim Shah (Pakistan) was elected Chairman of the Working Group. The Chairman, in his opening statement, reviewed the mandate of the Working Group for its tenth session and the status of the implementation of the recommendations of UNISPACE 82.

3. In accordance with resolution 50/27, paragraph 19, the Working Group of the Whole continued its assessment of the implementation of the recommendations of UNISPACE 82. The Working Group had before it a number of studies and reports prepared by the Secretariat, Member States and international organizations, contained in documents A/AC.105/614, Add.1, 2 and 3, and A/AC.105/625. The Working Group of the Whole also had before it two technical studies prepared by the Secretariat, one on micro- and small satellites: current projects and future perspectives for international cooperation (A/AC.105/611), and one on the use of remote sensing technologies for environmental applications, particularly in support of the recommendations of the United Nations Conference on Environment and Development (A/AC.105/632).

4. The Working Group noted that the Secretariat was also in the process of preparing additional technical studies on some of the subjects it had suggested at its thirty-first session, as outlined in document A/AC.105/571, annex II, paragraph 17, namely on the following subjects:

(a) Space applications for sustainable development;

(b) Developing tele-education programmes through international cooperation;

(c) Basic space science in developing countries.

5. The Working Group noted with satisfaction the valuable efforts of the United Nations, Member States and other international organizations to implement the recommendations of UNISPACE 82.

6. The Working Group agreed on the following conclusions and recommendations, keeping in view the priorities contained in General Assembly resolution 50/27, paragraph 17.

I. SHORT-TERM TRAINING AND LONG-TERM EDUCATION

7. The Working Group noted with appreciation that training courses and workshops in remote sensing, satellite communications and other topics have been organized for the benefit of developing countries with the assistance of the United Nations. Such courses and workshops on advanced applications of space science

and technology and on new technological developments should continue to be organized regularly. At the same time, the recent advances in space technologies and applications for development should be brought to the attention of planners, administrators and decision makers in the developing countries. Member States, particularly the developed countries, and international organizations are requested to support the training programme on an ongoing basis.

II. INTERNATIONAL AND REGIONAL COOPERATION

8. The Working Group noted with appreciation the reports prepared by the Office for Outer Space Affairs on the resources and technological capabilities of States in space activities as well as in the areas of education, training, research and fellowship opportunities for the promotion of cooperation in the peaceful uses of outer space. Those reports should continue to be periodically updated by the Office for Outer Space Affairs.

9. The Working Group recommended that in the light of the continued development of space activities, the Committee on the Peaceful Uses of Outer Space should request all States, particularly those with major space or space-related capabilities, to continue to inform the Secretary-General annually, as appropriate, about those space activities that were or could be the subject of greater international cooperation, with particular emphasis on the needs of the developing countries.

10. Similarly, the Committee should also request international organizations with space-related activities to continue to inform the Secretary-General annually concerning those space activities that were or could be the subject of greater international cooperation, with particular emphasis on the needs of the developing countries.

III. INFORMATION, STUDIES AND TECHNICAL ADVISORY SERVICES

11. The Working Group appreciated the preparation by the Secretariat of the studies and reports on space science, technology and its applications referred to in paragraph 3. The Working Group recommended that further studies should be undertaken by the Office for Outer Space Affairs, in view of the recommendations made by participants at workshops, training courses, conferences and symposia organized by the United Nations Programme on Space Applications. With emphasis on the needs of developing countries, those studies could address the following subject areas:

(a) Space technology applications for preventing and mitigating the effects of natural disasters;

(b) Use of new technologies in communications and information networks.

12. In order to promote the development of national space programmes, including higher education in space-related subjects, the United Nations should continue to arrange, upon request, for the provision of expert consultants from developed and developing countries to assist in the preparation of integrated national plans of action for initiating, strengthening or reorienting appropriate space applications programmes, which should be in conformity with other national development programmes.

IV. OTHER MATTERS

A. Priority areas

13. The Working Group considered that, in order to further promote the applications of space science and technology for development, priority should be given to the following areas:

(a) *Stimulation and support of the growth of indigenous nuclei and an autonomous technological base in space technology in developing countries*. UNISPACE 82 recommended the free exchange of scientific and technological information and an arrangement for the transfer of technologies to promote the use and development of space technology in the developing countries. UNISPACE 82 also recommended that countries should not place undue restrictions on the sale of components, subsystems or systems required for peaceful space applications. A greater international understanding therefore needs to be evolved to overcome the difficulties faced by the developing countries in this respect;

(b) *Promotion of a greater exchange of actual experiences in space applications*. UNISPACE 82 recommended appropriate assistance and called particularly upon international financial agencies to support demonstration projects to provide opportunities for hands-on experience in space technology and applications for the developing countries through direct involvement in such applications projects or pilot projects;

(c) *United Nations funding*. The Programme on Space Applications should be given the full support of the United Nations in order to fully implement the recommendations of UNISPACE 82. That recommendation was made on the understanding that the Office for Outer Space Affairs would give priority to the full implementation of the Programme on Space Applications within the available resources of its regular budget;

(d) *Voluntary contributions*. Appreciation was expressed for the support of Member States and international organizations in the form of cash and in-kind contributions for the activities being undertaken by the Programme on Space Applications for the implementation of the UNISCPACE 82 recommendations. Those Member States and international organizations were requested to continue their support and other Member States and international organizations were urged to provide cash and in-kind contributions for Programme activities, in particular those that are not implemented due to a lack of financing.

B. Third UNISPACE

Introduction

14. The Working Group of the Whole noted that, as reflected in General Assembly resolution 50/27, paragraph 31, the Scientific and Technical Subcommittee, at its thirty-second session, had continued its discussions on the possibility of holding a third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, and that the Committee continued the discussions at its thirty-eighth session with a view to promoting an early conclusion on the matter by the Committee.

15. The General Assembly, in paragraph 32 of its resolution 50/27, agreed that a third United Nations Conference on the Exploration and Peaceful Uses of Outer Space could be convened before the turn of the present century, and that, prior to recommending a date for the conference, there should be a consensus recommendation on the agenda, venue and funding of the conference.

16. The General Assembly, in paragraph 33 of its resolution 50/27, recommended that the Subcommittee, at its thirty-third session, should continue the work it had conducted at its thirty-second session, taking into particular account the report of its Working Group of the Whole (A/AC.105/605, annex II), with the aim being to complete the development and refinement of a framework that would allow an evaluation of proposals by the Committee at its thirty-ninth session, and that that framework should allow for the consideration of all possibilities of achieving the final objectives of such a conference.

17. In paragraph 34 of that resolution, the General Assembly agreed that on the basis of the work to be conducted by the thirty-third session of the Scientific and Technical Subcommittee, the Committee, at its thirty-ninth session, should consider all issues related to the possible convening of a third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, including its technical and political

objectives, a detailed and sharply focused agenda, funding, timing and other organizational aspects as well as whether the objectives of the conference could be achieved by other means, with a view to making a final recommendation to the General Assembly at that session of the Committee.

18. The text of the following paragraphs is based on the work done by the Working Group of the Whole at its ninth session, as reflected in its report (A/AC.105/605, annex II) and includes additional ideas expressed during the tenth session of the Working Group of the Whole. The Working Group of the Whole also had the benefit of the views expressed by Member States during the thirty-third session of the Scientific and Technical Subcommittee.

1. The objectives of the conference

19. The basic objective of the proposed third UNISPACE conference would be to promote effective means of using space technology to assist in the solution of problems of regional or global significance and to strengthen the capabilities of Member States, in particular developing countries, to use the applications of space research for economic, social and cultural development.

20. As a way of achieving this primary objective, the proposed conference should include a review of the recent developments in space activities, including advances in space technology, new economic and social applications, and economic factors limiting the development of space technology and its applications. On the basis of that review, a third UNISPACE conference would consider how States can make the best use of existing systems and opportunities and how international cooperation should be strengthened, where necessary, to provide new systems, applications and further opportunities for international cooperation for the general benefit of Member States. In particular, a third UNISPACE conference could consider, *inter alia*, how international cooperation in the field of remote sensing, weather and climate observations and environmental monitoring could be strengthened to promote the use of such systems by all States.

21. Together with the ways of achieving the primary objective, another objective or desirable result would be that developing countries would define their needs for space applications for development purposes in advance of any conference. At the same time, the conference would analyse the relationships between commercialization of space technology, national development plans and the building of indigenous capabilities with a view to further encouraging the partnership of the developing countries in the development and utilization of these technologies.

22. Another objective would be to consider ways of expediting the use of space applications in Member States to promote sustainable development, particularly through the implementation of the recommendations of Agenda 21 of UNCED as well as their participation in international programmes such as "Mission to Planet Earth" and the International Geosphere-Biosphere Programme or in various applications of satellite communications for commercial, educational or health purposes.

23. A third UNISPACE conference could address the various issues related to education, training and technical assistance in space science and technology and their applications aimed at the development of indigenous capabilities in all States to ensure that all can, in practice as well as in principle, use data from space systems.

24. The conference could serve as a valuable forum for increasing awareness of the general public regarding the benefits of space technology and critical evaluation of the value of space activities.

2. Organization of the conference

25. The organization of the Conference should permit the participation of all States Members of the United Nations, including those who are not members of the Committee on the Peaceful Uses of Outer Space.

26. Such a conference would require thorough preparation, and therefore the holding of such a conference in 1996 or 1997 is unrealistic. In addition, the resource requirements of the United Nations Programme on Space Applications should be carefully reviewed to ensure that the Programme could be effectively oriented towards conference preparations during the 18-month period prior to the conference. Such considerations should be taken into account in setting the date for the conference. In addition, the overall programme of major United Nations conferences should be taken into account in recommending a date in order to ensure that the financial burden is manageable within the scope of the overall United Nations budget.

27. The Working Group of the Whole noted that the Committee, at its thirty-eighth session, had agreed that at an appropriate time, following agreement on the holding of a conference, IAF, COSPAR, IAU and ISPRS, as well as other relevant organizations should be asked to prepare background documents. Those organizations could also be invited to organize, in cooperation with the host country, a UNISPACE forum to be held as part of the conference.

28. Recalling that space technology has an important role to play in economic and social development such as in implementing the recommendations of UNCED and Agenda 21, and that many countries which are not members of the Committee are or could be utilizing space technology for this and other purposes, the Working Group of the Whole agreed that a global conference on space, organized by the United Nations, could be an appropriate forum in which to discuss issues related to international cooperation, space policies, the participation of the private sector and implementation or follow-up actions relating to these questions as well as to other issues that might be of universal concern.

29. The Working Group of the Whole was of the view that the objectives indicated for a third UNISPACE conference could be better achieved if it examined space activity and international cooperation in this area as a whole and if during its preparatory phase, the forums provided by specialized groups and other regional or international conferences, symposia and meetings are utilized to define a few focused themes to be dealt with by a third UNISPACE conference.

30. In considering the convening of a third UNISPACE conference, the Committee should work with and involve major organizations in the above fields. These specialized groups may well be the best or most appropriate route to achieving the results required. Involving a group with a mandate in a specific field of space from the beginning, setting targets for it and asking it to report regularly on its progress is better than having all the recommended actions tied to a United Nations committee with limited resources. In addition, it would be desirable to identify mechanisms for input to and feedback from major funding organizations to pull through any resulting actions. The Conference could complement consideration of issues posed due to limited participation or focus of any of the specialized groups.

31. The Working Group agreed that the proposals it had made in 1995 (A/AC.105/605, annex II, paragraphs 13 through 59), the proposal made by the Group of 77 countries members of the Subcommittee in 1996 (see appendix I), the additional ideas put forward by the Czech Republic in 1996 on the holding of a UNISPACE III conference (see appendix II) and the proposal made by the United Kingdom in 1996, contained in the paper "Other means" (see appendix III), by which any objectives set for a conference could be addressed in other ways, contributed to the framework which would facilitate the work of the Committee in making a final recommendation on this matter, at its thirty-ninth session, to the General Assembly.

32. In addition to the proposals and the possibilities for other means, the Working Group of the Whole reached an understanding that if a conference (typically referred to as UNISPACE III) were to be convened, then the following could apply:

(a) The conference should ensure the participation of all countries, including those which are not members of the Committee;

(b) Any conference and the related preparatory procedures would allow the issues related to international cooperation on the development and utilization of space science and technology to be explored; in particular, this would allow the evaluation of the major development areas where space could make a substantive and cost-efficient contribution;

(c) Any conference would not be a simple repetition of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82), as space activities had significantly advanced since that time, and many of the issues covered at that time were now being achieved by other means;

(d) There are now a significant number of conferences and training courses each year on space, which are run on a world-wide basis with many such events specifically oriented to the needs of developing countries. Any United Nations event would therefore not aim at duplicating or replacing such regular and ongoing events. Such United Nations events might include the possibility of holding topical meetings organized under the United Nations Programme on Space Applications, in cooperation with relevant specialized agencies of the United Nations and international scientific organizations;

(e) Regional conferences or events could be convened to discuss matters of particular relevance or concern to the region, and any conclusions of such events could be passed on to the United Nations conference (or event) or the Committee, for consideration as appropriate;

(f) Any conference would draw on the available resources, infrastructure, facilities and services of the Committee and its subcommittees;

(g) The outline of an agenda for any conference will be detailed following agreement on the holding of a third UNISPACE or other appropriate event.

3. Examination of achieving the goals set for the conference by other means, including intensification of work in the Committee

33. The Working Group of the Whole noted that, through intensification of its work, the Committee could address several of the items which would result from an agenda based on some of the objectives that have been indicated. The Committee could also invite experts in relevant fields to make presentations to it and to prepare working documents to be reviewed by the Committee.

34. The Committee could also invite contributions, to be presented at its sessions, from a number of groups that specialize in a field of space science or technology to review recent scientific and technological developments. The Working Group of the Whole noted that groups such as the Space Agency Forum, the Committee on Earth Observation Satellites, the International Astronautical Federation, the Committee on Space Research and the Inter-Agency Space Debris Coordination Committee and other such regional or international groups could provide the Committee with a valuable view of the current status and the expected developments in their respective fields.

35. The Working Group of the Whole also noted that some elements to be pursued in fulfilling the objectives of a possible third UNISPACE conference could be addressed in regular or ad hoc meetings of the groups referred to above as well as in regional or international conferences, symposia or meetings that address a range of themes and applications. The Committee, in considering the preparations for a possible third UNISPACE conference, should provide appropriate endorsement for the regular activities of these other bodies in dealing with matters of relevance to the Committee.

36. Specialized groups, such as those referred to above, should be invited to participate in preparing realistic goals so that a possible third UNISPACE conference complements and adds to the activities of these other

bodies. The Committee would also request those bodies to assist in reaching achievable plans for follow-up actions that fall within their mandates.

4. Additional ideas for consideration

37. Some delegations considered that the current proposals for a conference are inappropriate at the present time, given the general budgetary constraints of the United Nations and its Member States. Some delegations observed that the agenda and the objectives of the conference proposed by the Group of 77 were too broad and diffused to ensure an action-oriented outcome of the conference. Those delegations emphasized the need to sharply focus on a limited number of issues on which concrete agreements would be reached to promote practical international cooperation. When such issues are identified, it would be necessary to make an alternative arrangement for the proposed United Nations conference which would specifically achieve the objective of the event. Other delegations were of the firm view that the proposals made by the Group of 77 in their Paper, submitted to the Working Group of the Whole in February 1996, provide options for alternative financial measures that could allow the holding of a third UNISPACE conference, in pursuance of the objectives identified by the Working Group of the Whole, which are indeed well focused. It was however pointed out that the defrayal of any additional financial obligations resulting therefrom would not constitute an alternative financial measure.

38. Some delegations considered that an appropriate meeting of the Committee (or of one of its subcommittees) could be held in conjunction with a World Space Exposition; the aim would be to display programmes, applications, technology and solutions generally made possible by space science and technology. This should help catalyse appropriate forms of coordination, collaboration and communication on space, promote the universal application and utilization of space science, and assist in demonstrating the need for continuity and complementarity of data in applications of space technology. Other delegations were of the view that such a meeting still falls short of the goals of the conference ensuring participation of all States.

39. Some delegations proposed to hold an ad hoc special session of the Committee open to all States with a focus on technical cooperation for the application of space science and technology to development provided that during the year of such an event, there would be no regular sessions of the Committee and its subcommittees, except for the meetings of the preparatory committee for the ad hoc special session of the Committee. Other delegations were of the view that the agenda for such a session should meet the needs of all States and that ensuring participation at a higher level of policy- and decision makers is essential to any scheme of such a meeting.

40. Some delegations proposed that the third UNISPACE conference could appropriately be convened in 1998, before the 53rd session of the General Assembly to enable it to consider the report of that conference.

41. Some delegations considered that the General Assembly could devote two special plenary meetings to the implementation of a preparatory phase and an open-ended session of the Committee on the Exploration and Peaceful Uses of Outer Space, and to designate those meetings as an international conference on the exploration and peaceful uses of outer space, taking particular account of the needs of the developing countries, which should take place at an appropriate global policy-making level and in keeping with the procedures and practices of the General Assembly.

42. Some delegations expressed the view that a special session of the Committee, open to all Member States of the United Nations at the ministerial level could be convened, aimed at examining the ample benefits made available by space technology, taking special consideration of the needs of the developing countries. This international conference would be preceded by two special sessions of the United Nations General Assembly.

43. Some delegations expressed the opinion that in order to adhere to the objectives indicated in section I above and to ensure a tangible output at the national, regional and international levels, the conference should

be universal so far as the participants are concerned and should include participation of high-level policy- and decision makers.

C. Future work

44. The Working Group recommended that it be reconvened next year to continue its work.

Appendix I

VIEWS OF THE GROUP OF 77 COUNTRIES MEMBERS OF THE COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE REGARDING THE HOLDING OF THE THIRD UNISPACE CONFERENCE

(Proposal submitted by the Group of 77 at the tenth session of the Working Group of the Whole: February 1996)

1. The General Assembly, in its resolution 50/27, paragraph 32, agreed that a third United Nations Conference on the Exploration and Peaceful Uses of Outer Space could be convened before the turn of the present century, and that, prior to recommending a date for the Conference, there should be a consensus recommendation on the agenda, venue and funding of the Conference.

2. The General Assembly, in paragraph 33 of the same resolution, recommended that the Subcommittee should continue the work it had conducted at its thirty-second session with the aim being to complete the development and refinement of a framework that would allow an evaluation of proposals by the Committee at its thirty-ninth session, and that this framework should allow for the consideration of all possibilities of achieving the final objectives of such a Conference.

3. The Group of 77 has thoroughly analysed the views that have been presented over a number of years by all members of the Subcommittee on the issue of the possible holding of a third UNIPSACE Conference, including whether the objectives of the Conference could be achieved by other means. The following reflects the consensus views of the Group of 77 on this issue.

4. The essential aspects of the rationale for and objectives of a third UNISPACE Conference have been presented through working papers and statements by Member States to the Committee and its subsidiary bodies, and include the following:

(a) The Conference should ensure the participation of all countries, not only those which are members of the Committee, many of which are already making significant use of space technology in their economic and social development plans, but also those which are just beginning or planning to do so;

(b) The Conference is the only forum where high-level policy- and decision makers in the technical, political and legal areas can become sensitized to and analyse the issues related to international cooperation and to the development and utilization of space science and technology to support the major development areas where space can make a substantive and cost-efficient contribution;

(c) The Group of 77 has presented clear objectives for the Conference, and these objectives are of primary importance for the developing countries. These objectives, together with those of other countries, can lead to a clear and sharply focused agenda for the Conference and to the expectation of a concrete and pragmatic outcome.

5. On other issues, such as the timing, venue and funding of the Conference, the Group of 77 has, on several occasions, indicated its willingness to find the most appropriate ways and means to hold such a Conference in the most cost-efficient and productive manner.

6. The Group of 77 is of the considered view that an expanded or special session of the Committee on the Peaceful Uses of Outer Space, or of the Fourth Committee of the General Assembly during its consideration of the report of COPUOS, would not adequately meet the objectives of the third UNISPACE Conference.

7. The Group of 77 noted that two major United Nations conferences are held annually in accordance with the normal practice of the United Nations.

8. Having thoroughly considered various options, in view of the foregoing, the Group of 77 proposes the following options:

(a) The third UNISPACE Conference could be scheduled as one of the two major United Nations conferences in a particular year, and it could thus be financed within the zero growth budget policy followed by the United Nations.

OR

(b) In the year of the third UNISPACE Conference, the regular meetings of the Committee and its subsidiary bodies would be scheduled, on an exceptional basis, in the following manner. The Scientific and Technical Subcommittee would meet for one week, to be followed by a two-week session of the Legal Subcommittee. The Main Committee would meet for one day, before the actual holding of the third UNISPACE Conference to adopt the reports of the two subcommittees. The savings of four weeks of session-related expenses obtained in this manner would offset a large part of the United Nations costs of the Conference. The Conference would thus have limited additional requirements, if any, for documentation, interpretation and other services.

9. Moreover, in accordance with the normal practice of the United Nations, if the Conference is hosted by a Member State at a venue other than at United Nations Headquarters, all additional financial obligations resulting therefrom as compared with the expenditure which would have been incurred if the Conference had been held at United Nations Headquarters would be borne by that country.

10. The Group of 77 is also of the view that the recommendations of the Conference would be limited in number, sharply focused, having significant impacts on the economic and social development of all countries.

11. Bearing in mind the above considerations, and also that the agenda of a third UNISPACE Conference should be focused, well balanced and consistent with the interests and needs of all countries, the Group of 77 has drafted a possible agenda for the third UNISPACE Conference. This agenda, presented below, is based largely on the work done by the Working Group of the Whole at its 1995 session.

POSSIBLE AGENDA FOR A THIRD UNISPACE CONFERENCE

(Proposed by the Group of 77)

1. The agenda of the Conference could be organized with the following central themes and subjects:

   (a) Advancements in space science and technology;

   (b) Applications of space science and technology and their dissemination;

   (c) Enhancing international cooperation in the utilization of space technology and applications;

   (d) Promoting the economic efficiency and commercial benefits resulting from developments in space science and technology.

2. Areas of particular emphasis should include:

(a) Opportunities and means for increased international cooperation in view of major developments in space science and technology;

(b) Expansion of participation of all countries in major international initiatives related to outer space activities;

(c) Promoting national, regional and international programmes aimed at environmental protection, including disaster mitigation and relief and sustainable development;

(d) Commercial benefits of the developments in space science and technology.

3. The following is the detailed agenda for a third UNISPACE Conference:

Committee I: Advancements in, and applications of, space science and technology

A. Advancements in space technology

1. Evaluation of major developments in space science and technology and assessment of their utility for future economic and social development.

2. Development of joint projects in the fields of space science, technology, applications and exploration.

B. Applications of space science and technology

1. Environmental applications:

(a) Examining ways of improving space-based monitoring of the state of the global environment and improving archives, dissemination, use and exchange of Earth observation data; application of space technology in monitoring the environment at local and regional scales. Examination of mechanisms to integrate space technology and applications into international programmes to promote environmental protection and economic development;

(b) Improving international cooperation in development and implementation of satellite-based disaster warning systems and utilization of space technology for mitigation and relief in natural, technological and industrial disaster situations;

(c) Enhancing cooperation in the collection and dissemination of meteorological data from satellites and other sources.

2. Remote sensing:

(a) Improving capabilities for the reception, processing and utilization of remote sensing data for sustainable development and management of natural resources;

(b) Improving distribution systems to ensure availability of remote sensing data, especially to developing countries, and ensuring the complementarity of remote sensing data.

3. Navigation:

(a) Improving methods to ensure continuity in the availability of satellite-based position-location/navigational services and exploring the possibility of cooperative global navigational satellite systems;

(b) Enhancing international cooperation in satellite-based search-and-rescue systems, including development of common standards for ship and aircraft locator beacons;

(c) Use of microwave systems for geophysical studies and oceanographic research.

4. Communications:

(a) Promoting regional cooperation in the planning, design, operation and utilization of satellite communication and broadcasting systems;

(b) Examining the uses of mobile satellite communications and other new technologies, including low-cost, lightweight satellites in non-geostationary orbits (lightsats), for rural communications;

(c) Promoting other uses of satellite-based systems, notably for tele-education, tele-medicine and family welfare, and emergency communications;

(d) Examination of issues related to transnational satellite direct broadcasting, including protection of intellectual property rights.

5. Education:

(a) Promoting space technology as a tool in mass literacy campaigns and distance education;

(b) Improving the methodology for educational processes.

6. Secondary applications of space technology:

(a) Potential uses of space for manufacturing specialized/unique products and materials;

(b) Industrial applications of spin-offs from space technologies.

Committee II: International cooperation and economic benefits

A. International cooperation

1. Review of existing mechanisms for international cooperation in space activities, consideration of ways and means for enhancing cooperation among Member States, the United Nations, its specialized agencies and other international organizations, with particular emphasis on the United Nations Programme on Space Applications.

2. International cooperation in maintaining and using the outer space environment — scope for new initiatives.

3. Examination of the role of space technology in promoting international peace and security, including the development of confidence-building measures for space activities and the conversion of military space technology for civilian purposes.

4. Review of the current status of and the need for continued progressive development and codification of the law of outer space, including ways and means of promoting wider adherence to international space treaties, establishment of guidelines for international cooperation in space exploration and utilization, and examination of links between space law and other branches of international law, such as environmental law.

B. Economic benefits

1. Ways and means of increasing the economic efficiency of space technology and its applications.

2. Promoting the commercial benefits of space activities including, *inter alia*:

(a) Design, development and use of mini- and micro-satellites for space research;

(b) Better, faster and cheaper means of reaching space, including the case of human space flight.

Additional scientific and technical component of a third UNISPACE conference

1. In order to ensure adequate discussion of scientific and technical issues, particularly as they relate to the items on the agendas of Committee I and Committee II, it is proposed that, in addition to the regular Committee sessions, there be an additional scientific and technical component in the form of the following:

Poster sessions: A series of scientific poster sessions should be held at the conference facility and be open to participants and observers throughout the conference. The posters/papers will highlight the results from ongoing scientific and technical space projects and will be presented by national space agencies and international scientific organizations;

Public evening lectures: To be given by eminent scientists in various space-related scientific disciplines on subjects of broad interest to conference participants and the general public;

Workshops/seminars: To be held as part of the conference and to be organized by interested specialized agencies of the United Nations and other international organizations on topics relevant to their expertise and mandates. For example: communications (ITU), remote sensing (CEOS/FAO/UNEP), navigation (ICAO/IMO), meteorology (WMO), basic space science (UNESCO/COSPAR/IAF) and astronomy (IAU). For appropriate use of time and resources, all relevant international organizations could include in their future sessions activities designed to ensure that their results enrich a third UNISPACE conference.

Appendix II

PROPOSAL ON HOLDING THE UNISPACE III CONFERENCE

(Proposal submitted by the Czech Republic at the tenth session of the Working Group of the Whole: February 1996)

The rationale

1. The main reasons for convening UNISPACE III are:

(a) To evaluate major developments in space science and technology and assess their utility for future economic and social development;

(b) To evaluate the influence of world-wide computer networks on space applications and assess the needs for access to networks, in particular in developing countries;

(c) To develop cooperative projects, in particular among developing countries, in the field of space applications.

The preparatory and advisory committees

2. As a first step, the General Assembly will be requested to appoint, at its session in 1996, COPUOS as Preparatory Committee, the Scientific and Technical Subcommittee as Advisory Committee, and OOSA as Executive Secretariat of the Conference.

3. The Advisory Committee, at its session in 1997, will select key space applications, such as:

(a) Remote sensing of the Earth and of the environment;

(b) Disaster prevention and mitigation;

(c) Satellite communications (possibly including direct television and radio for education);

(d) Meteorology (possibly together with geodesy);

(e) Spin-off benefits.

Topical meetings

4. For the above applications, the United Nations Programme on Space Applications will organize, in cooperation with relevant United Nations specialized agencies and international scientific organizations, topical meetings at various venues, in particular in developing countries. The agenda will be set up from relevant items listed in the informal working paper of the Group of 77, and from other sources. The participants will be experts in the individual fields and high officials of space agencies of countries interested in space applications. Each topical meeting will report to the Advisory Committee on its findings and recommendations, in particular on the perspectives and requirements for development. The time span for the topical meetings will be 1997-1998.

Draft global report

5. The Scientific and Technical Subcommittee, at its session in 1999, will make a synthesis of the results of topical meetings and prepare a draft global report on the state of and perspectives for space applications, for circulation to and comments from Member States of the United Nations.

UNISPACE III

6. COPUOS will invite all Member States of the United Nations to attend its session in 2000. To enable participation at a high level, the session will be held under the title UNISPACE III. The task of UNISPACE III will be to consider and adopt the global report on the state of and perspectives for space applications.

Implementation

7. The decisions and recommendations of UNISPACE III will be formulated in such a way as to make possible their implementation within two years.

Appendix III

OTHER MEANS

(Proposal submitted by the United Kingdom at the tenth session of the Working Group of the Whole: February 1996)

The organizations and activities listed below provide possible alternative means of meeting the objectives of a third UNISPACE conference.

International Astronautical Federation (IAF). Astronautical congress which includes symposia on space and natural disaster reduction, Earth observations, microgravity sciences and processes, satellite communications, space and education, space exploration, space power, space propulsion, space station, space systems and space transportation; sponsorship of conferences, workshops and regional events.

Committee on Space Research (COSPAR). Plenary meetings which cover a broad range of scientific issues related to space and co-sponsored meetings.

Committee on Earth Observation Satellites (CEOS). Membership encompasses all agencies responsible for Earth observation satellite programmes, along with agencies that receive and process data from space. Some international organizations such as the Office for Outer Space Affairs, WMO and UNEP have affiliate status.

International Academy of Astronautics (IAA). Reports, organization of symposia on space safety and rescue, economics in space applications, history of astronautics, space plans and policies, interstellar space exploration, multilingual astronautical terminology, space activity in society, Search for Extraterrestrial Intelligence (SETI), small satellite missions, colloquium on the law of outer space and remote sensing.

Inter-Agency Space Debris Coordination Committee (IADC). Technical forum of space-faring nations formed to share data on the measuring, modelling and mitigation of orbital debris. IADC also develops cooperative research projects associated with measuring and modelling the space debris environment.

International Society for Photogrammetry and Remote Sensing (ISPRS)

Space agency sponsorship of events, e.g. United Nations/ESA and other training programmes

Activities and reports of organizations in the United Nations system (e.g., FAO, UNESCO, ITU, WMO, United Nations Institute for Disarmament Research) and of United-Nations-affiliated regional centres for space science and technology education

Other events: Albuquerque (on nuclear power sources and other subjects), etc.

Updating and focusing the work of the Committee and its subcommittees

General Assembly special theme day on space